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Special Issue: The Food Environment in Canada, Part I

Inside this issue

263 Commentary – Food for thought on food environments in Canada

266 The healthfulness and prominence of sugar in child-targeted breakfast cereals in Canada

274 Food marketing to children in Canada: a settings-based scoping review on exposure, power and impact

293 Development, reliability and use of a food environment assessment tool in supermarkets of four neighbourhoods in Montréal, Canada

303 Support for healthy eating at schools according to the comprehensive school health framework: evaluation during the early years of the Ontario School Food and Beverage Policy implementation

313 The Ontario Food and Nutrition Strategy: identifying indicators of food access and food literacy for early monitoring of the food environment

320 Other PHAC publications

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Commentary

Food for thought on food environments in Canada

Lana Vanderlee, PhD, Guest Editor; Mary R. L'Abbé, PhD

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As a whole, the environments in which we make our food choices do not typically reinforce and support healthy behaviours. The Canadian food environment in which we live, work, and play is failing to provide and promote healthy diets; as a result, Canada has seen high and continually rising rates of overweight and obesity and diet-related non-communicable diseases (NCDs) across the life course and among all sectors of society, with particularly high rates among vulnerable populations (such as Indigenous populations and those with low socioeconomic status). Swinburn and colleagues conceptualized the food environment as "the collective physical, economic, policy and sociocultural surroundings, opportunities and conditions that influence people's food and beverage choices and nutritional status."[1] The scope of what is captured by the term "food environment" is broad, and includes such areas as food access and availability; food promotion and pricing; food labelling; the nutritional composition of the food supply and foods provided in public and private sector settings; and the retail food environment. These areas are influenced by the major actors that play roles in establishing a healthy food environment, including government (health, education, agriculture, finance, and international trade, among others), the food industry, and civil society more broadly.

Importantly, policies, interventions and actions aimed at improving the food environment shift the responsibility for improving dietary habits from individual responsibility for behaviours and choices to the collective environmental factors that support (or discourage) healthy food choices. This population-level approach works to shift the curve for both the high-risk and general populations, and focuses on interventions that have a broad reach and scope, while acknowledging the variety of societal factors that drive social norms and social structures that can endorse or impede healthy behaviours. Health-promoting food environments serve to make the healthy choice not only the easy choice, but also the most accessible, available, affordable, and preferred choice for consumers.[2]

Globally, there appears to be a significant window for policy action to address the food environment. The United Nations (UN) *Political Declaration of the High-level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases*[3] in 2011 set the stage for global efforts combating diet-related NCDs, which led to the World Health Organization's (WHO) *Global Action Plan for the Prevention and Control of NCDs*.[4] Subsequently, the *WHO Report of the Commission on Ending Childhood Obesity*[5] and *Set of Recommendations on the Marketing of Foods and Non-alcoholic Beverages to Children*[6] set out strong policy recommendations for improving aspects of the food environment, among other major documents and efforts. At the country level, Brazil's revolutionary food guide[7], which encompasses a holistic view of healthy eating, Mexico's excise tax on beverages with sugar and calorically-dense foods[8], and Chile's comprehensive policies on food labelling and marketing to children[9] are a few examples of cutting edge policies that have been implemented to support and reinforce a healthy food environment. Within Canada, the announcement of the *Healthy Eating Strategy*[10] will, if fully implemented, position Canada as a world leader in tackling multiple dimensions of the food environment through innovative and comprehensive policy and programming.

The September and October special issues of this journal aim to deconstruct aspects of the Canadian food environment across a variety of domains, and demonstrate some of the opportunities for major actors to take action in this area. In this September issue, the article by Potvin Kent et al.[11] examines the relative 'healthiness' of breakfast cereals in the Canadian food supply, which are commonly targeted towards children and families via advertising on food packages and in mainstream media channels. They found that the nutritional profile of cereals with advertising targeted towards children was of particularly poor quality. The article by Prowse[12] examines food marketing policies using a settings-based approach to determine what policies are currently in place to limit the power and the exposure of marketing to young audiences who are particularly vulnerable to such practices. Both the Potvin Kent and Prowse articles highlight policy options for decreasing the impact of marketing as well as the need to engage with the food industry to move forward on an agenda for improving the quality of the food supply.

Jalbert-Arsenault et al.[13] explore aspects of marketing and promotion of foods within supermarkets, one of the most proximal retail environments that can significantly influence consumer food choices at the point of sale. They used a tool developed to measure the availability, price, promotion and placement of healthful (i.e., vegetables and fruit) and less healthful (i.e., ultra-processed food products and carbonated beverage) items. The great variation in retail environments between different chain supermarkets in one low-to-medium-income neighbourhood in Montréal, and the high proportion of larger retailers promoting the sale of ultra-processed food products to a greater extent than their

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healthier counterparts, defies the common definition of supermarkets as 'healthy' food outlets and highlights the opportunity for health promotion within consumer retail food environments.

The article by Orava and colleagues[14] explores the implementation of mandatory nutrition standards in school settings in Ontario to promote healthy eating among students using a Comprehensive School Health approach. Orava identifies that while the physical environment within schools may support healthy eating, the social environment is not uniformly conducive to improving healthy eating. Engaging with stakeholders and champions within programs is likely to increase uptake and implementation of policy. The article provides insight into the importance of the context within which policy is it implemented, and a need for a policy approach to implementing Comprehensive School Health to promote healthy eating and behaviours in the school environment.

Lastly, with increasing global activity in food environment policy, monitoring is critical to understand the extent of implementation and evaluate the impact of policy. In this September issue, Boucher and colleagues[15] explore indicators of healthy food access, food literacy, and food environments using publicly available data already collected in Ontario and in Canada, and identify major gaps that currently prevent thorough monitoring in Ontario. As efforts to improve the food environment move forward in Canada, comprehensive data at the federal, provincial and municipal levels will be increasingly required to map and monitor progress in improving both the food environment and dietary habits. Within Canada, Raine and colleagues have developed the Report Card for Healthy Environments that is currently used in Alberta to comprehensively monitor the status of the food environment and provide recommendations for action.[16] This is on trend with efforts to monitor food environments globally, such as the International Network for Food and Obesity/noncommunicable Diseases Research, Monitoring and Action Support (INFORMAS). INFORMAS is a group of academic and public-sector stakeholders who have worked to collectively establish a set of common methods which can be used to monitor food environments globally, and this work is ongoing in Canada.[1]

The diversity of articles in this special issue underscores the breadth of work being conducted within Canada to fill evidence gaps and inform policy to address healthy eating. Dietary behaviours are the leading behavioural risk factor for death globally, greater than tobacco, alcohol use, and physical inactivity.[17] As policies and interventions are implemented in Canada to shift the food environment towards one that is health-promoting, the monitoring and subsequent evaluation of the impact of these efforts will be critical to identify future directions to improve the diet and health of Canadians.

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The healthfulness and prominence of sugar in child-targeted breakfast cereals in Canada

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Abstract

Introduction: The objective of this study was to compare the nutritional content and healthfulness of child-targeted and "not child-targeted" breakfast cereals and to assess the predominance of added sugar in these products.

Methods: We collected data on the nutritional content of 262 unique breakfast cereals found in the five largest grocery store chains in Ottawa (Ontario) and Gatineau (Quebec). We noted the first five ingredients and the number of added sugars present in each cereal from the ingredients list. The various cereal brands were then classified as either "healthier" or "less healthy" using the UK Nutrient Profile Model. We assessed each cereal to determine if it was child-targeted or not, based on set criteria. Statistical comparisons were made between child and not child-targeted cereals.

Results: 19.8% of all breakfast cereals were child-targeted, and these were significantly lower in total and saturated fat. Child-targeted cereals were significantly higher in sodium and sugar and lower in fibre and protein, and were three times more likely to be classified as "less healthy" compared to not child-targeted cereals. No child-targeted cereals were sugar-free, and sugar was the second most common ingredient in 75% of cereals. Six breakfast cereal companies had child-targeted product lines that consisted entirely of "less healthy" cereals.

Conclusion: There is a need for regulations that restrict food marketing to children and youth under the age of 17 on packaging to reduce their appeal to this age group. Children's breakfast cereals also need to be reformulated through government-set targets, or through regulation should compliance be deemed unacceptable.

Keywords: breakfast, children, nutrition, cereal, obesity, food supply, sugar, marketing

Highlights

- Compared to not child-targeted cereals, child-targeted cereals were
  - significantly lower in fibre, protein, total fats and saturated fat; and
  - significantly higher in sodium and sugar.
- Child-targeted cereals were three times more likely to be categorized as "less healthy" than not child-targeted cereals.
- There were no child-targeted cereals that were sugar-free, and the majority contained two to three types of added sugar.
- Six breakfast cereal companies had child-targeted product lines that consisted entirely of "less healthy" cereals.

Introduction

The developed world has experienced a substantial increase in childhood overweight and obesity, with rates doubling between 1980 and 2008.[1] This has led to an increased risk of cardiovascular diseases, diabetes, musculoskeletal disorders and various cancers globally.[2] The rate of childhood obesity in Canada has increased dramatically over the last three decades from 2% in 1981 to 12% in 2009 to 2011, and the combined rate of overweight and obesity in children aged between 5 and 17 years currently stands at 31.5%.[3,4]

Food and beverage marketing has been associated with childhood obesity, in addition to children's food preferences, short-term food intake and food requests.[5,6] Research has shown that the majority of the products being advertised to children and youth are high in fat, sugar and sodium, with little nutritional value.[7-9] The World Health Organization (WHO) has recommended that countries limit the volume of food and beverage marketing seen by children in all media forms, and in places where children gather.[10] The former includes package labelling. Food and beverage marketing in Canada is mostly self-regulated by industry through the Children's Food and Beverage Advertising Initiative (CAI).[11] The CAI was launched in 2007 by 16 food and/or beverage companies that pledged either to advertise only healthier products or to stop advertising to children under the age of 12 years on television, radio and print and in digital media (such as on the Internet and on smartphones). No pledges have been made with regard to food wrapping or package labels. In Quebec, all commercial advertising to children under the age of 13 years is prohibited through the *Consumer Protection Act* (CPA), which was implemented in 1980 to protect children from marketing in general.[12] This law prohibits advertising to children in most media forms, including television and the Internet, in schools and daycare centres. Package labelling is excluded, however, so

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children in Canada are not protected from marketing on packaged products in any jurisdiction.

Breakfast cereals are a product category that is heavily marketed to children. In the US, research has shown that on average, in 2015, children aged 2 to 11 years viewed over 500 breakfast cereal ads on television alone,[13] and in 2009, cereal marketing to children ranked second in terms of advertising spending, falling behind only quick service restaurant ad spending.[14] In Canada, children aged 2 to 11 years view on average 33 breakfast cereal ads per month on television alone.[15] Breakfast cereal is the third most frequently advertised product category and constitutes 11% of the advertising on both children's television and on children's preferred websites.[16,17]

In the United States, research has shown that the nutritional content of breakfast cereals targeted at children is extremely poor.[18,19] An analysis of all child-targeted foods sold in Canadian supermarkets in 2008 showed that 93% of breakfast cereals derived over 20% of their calories from sugar.[20] Higher sugar intake by children (and particularly sugar-sweetened beverages) has been shown through meta-analysis to be associated with a higher risk of obesity.[21] Results such as these are cause for concern among public health officials.

No Canadian study has specifically focussed on the overall nutritional content of breakfast cereals that target children or has compared child-targeted cereals to those not directed at children. Given the high prevalence of breakfast cereal marketing to children, the primary objective of our research was to compare the nutritional content and healthfulness of child-targeted and not child-targeted breakfast cereals. A secondary objective was to determine the predominance of added sugar in children's breakfast cereals in Canada. This latter objective is particularly salient, as Health Canada has recently reviewed food labelling regulations and has proposed that sugars be grouped in the ingredients list to allow consumers to more easily identify sources of sugar in food products.[22] It was expected that breakfast cereals targeted at children would be less healthy than cereals not targeted at children, and would contain a larger amount of sugar. Finally, the third objective of this study was to determine which companies should improve the healthfulness of their cereals marketed to children.

Methods

We designed a cross-sectional study to assess the nutritional content and healthfulness of the child-targeted and not-child targeted cereals.

Collection of nutritional data

Three undergraduate-level research assistants in their fourth year of study visited a convenience sample in Ottawa (Ontario) and Gatineau (Quebec) of the top five food retailers in Canada according to sales,[23] including Loblaws, Sobeys (owned by Empire Co.), Metro, Costco and Wal-Mart, and compiled a list of all cold breakfast cereals sold. They removed duplicates and recorded company names. A research assistant then visited the stores in question and took photos of each side of every cereal box on the list. The nutritional information of each cereal (without milk added) was taken directly from the Nutrition Facts table on the box. The nutritional information collected included the serving size (g), total number of calories (cal), trans fat (g), saturated fat (g), sodium (mg), fibre (g), sugar (g) and protein (g). With the exception of trans fats, the collection of these nutrients was required in order to classify foods as "healthier" or "less healthy." We collected trans fats regardless, as they have been shown to be particularly harmful to health, given that they increase serum low-density lipoprotein (LDL) and lower serum high-density lipoprotein (HDL) levels.[24]

For each cereal, the number of added sugars was obtained from the ingredients list, and their place in the ingredients list was noted. Health Canada regulations specify that ingredients on prepackaged food products must be declared according to their weight and in descending order.[25] Added sugars included the presence of agave, brown sugar, cane sugar or evaporated cane juice, concentrated fruit juice, corn syrup, dextrose or dextrin, fructose, galactose, glucose, glucose-fructose, high fructose corn syrup, honey, invert sugar, liquid sugar, maltose, maple syrup, molasses, nectar, raw sugar, sucrose, syrup and white sugar. Next, the first five ingredients presented in the cereal ingredient lists were noted in the order in which they appeared.

Nutritional classification

Foods were classified as either "healthier" or "less healthy" using the three-step UK Nutrient Profile Model developed by the UK Food Standards Agency.[26] This nutrient model was selected because it has good validity and reliability,[27,28] and has been used effectively in various research studies to accurately determine the nutritional quality of foods.[7,29] To conduct this classification, each nutrient was converted to 100 g of the cereal and points were allocated based on the amount of energy (kJ), saturated fat (g), total sugar (g), protein (g), fibre (g), sodium(mg) and the percentage of fruits, vegetables and nuts according to tables provided by a guidance report on the UK Nutrient Profile Model.[26] The following calculation was then completed for each cereal: (energy points + saturated fat points + sugar points + sodium points) − (fruit, vegetable and nuts percentage points + fibre points + protein points). A product with less than four points was considered "healthier" and those with four or more points were considered "less healthy."[26]

Assessment of child-targeting

The definition of "child-targeted" we used was based on previous research on food and beverage marketing to children on packaging and on television.[30,31] A breakfast cereal was considered to be directed towards children if it featured candy; child-directed images (e.g. cartoons); child-directed messages designed to get their attention (e.g. "Hey Kidz"); encouraged their interaction with the product (e.g. puzzles or games); mentioned children in their brand name or logo; included tie-ins to children's TV shows, movies, or musical acts; or used primary colours and cartoon-like fonts in order to appeal to children. If none of the items from the above list applied, the cereal was classified as "not child-targeted." To conduct this classification, all six sides of the cereal boxes were examined by two of the research assistants and any disagreements were resolved by the principal researcher. Interrater reliability was 95% and was calculated as follows: 1 − (12 disagreements / 262 cereals) × 100. All data collection was conducted in the fall of 2015.

Statistical analysis

We conducted statistical analyses using IBM SPSS Statistics version 23.0 (IBM Corp., Armonk, NY, USA). An analysis of the mean ($\bar{x}$) and standard deviation (SD) of each

nutrient was conducted for the total sample and then for child-targeted and not child-targeted cereals. We completed *t* tests to assess whether differences were statistically significant. We computed the number of "healthier" and "less healthy" breakfast cereals, and calculated chi square (χ^2) and the odds ratio to assess differences between child-targeted and not child-targeted cereals. Next, the number of child-targeted and not child-targeted "healthier" and "less healthy" cereals per company was determined. Companies with few cereal products (i.e. fewer than five products) were collapsed into an "other company" category. The companies in this category included Dorset Cereal, Small Planet Foods, A&V 2000 Inc., Fourmi Bionique, naturSource, Empire Company Limited, Food for Life, GoGo Quinoa, Swissli, Wal-Mart and WildRoots. Finally, the number of sugars per cereal and the ordering of ingredients were tabulated and descriptive statistics were used to examine the proportion of foods that contained added sugar and to calculate the number of times that added sugar appeared in the ingredients list.

Results

The total number of unique breakfast cereals located was 266; however, four cereals were not found during subsequent visits to the grocery stores as they had been discontinued. Therefore, we analyzed 262 cereals. Fifty-two (19.8%) of 262 cereals were found to target children. On average, child-targeted cereals were significantly higher in both sodium (containing 439.7 mg on average, compared to not child-targeted cereals, which had 266.2 mg) and sugar (containing 30.2 g on average, compared to not child-targeted cereals, which had 19.2 g) (Table 1). Child-targeted cereals were also significantly lower in fibre (containing 5.2 g on average compared to not child-targeted cereals with 9.6 g), as well as protein (containing 6.3 g on average compared to not child-targeted cereals with 10.0 g on average). In contrast, child-targeted cereals were significantly lower in total fat (containing 3.6 g on average compared to not child-targeted cereals with 7.2 g) and saturated fat (containing 0.7 g on average compared to not child-targeted cereals with 1.5 g). The majority of both child-targeted and not child-targeted cereals were classified as "less healthy" by the UK Nutrient Profile Model (as shown in Table 2) and there was a significant association between healthfulness and child-targeting (χ^2 = 7.6 (*df* = 1), *p* = .006). Child-targeted cereals were 3.0 times more likely to be classified as "less healthy" compared to not child-targeted cereals.

Overall, only 7.3% (n = 19) of breakfast cereals were sugar-free and the greatest number of cereals had between two and three types of sugar (n = 127; 48.5%) as shown in Table 3. No child-targeted cereals were sugar-free and the greatest number (n = 31; 59.6%) contained 2 to 3 types of added sugars. A total of 9% (n = 19) of not child-targeted cereals were sugar-free and 45.7 % (n = 96) contained 2 to 3 different added sugars. Almost 6% of these cereals (n = 12), contained between 7 and 11 different types of sugar.

Overall, the most common first ingredient was oats (38.9%), while sugar was the most common second and third ingredient (44.3% and 35.5%, respectively) as shown in Table 4. The most common first ingredient in child-targeted cereals was corn (30.8%), followed by whole wheat (26.9%) and oats (19.2%). Sugar was the most common second and third ingredient (75% and 32.7%) for child-targeted cereals. For not child-targeted cereals, the most common first ingredient was oats (43.8%), followed by whole wheat (16.7%) and rice (11.9%). The most common second and third ingredient for these cereals was sugar, in 26.7% and 36.2% of cases, respectively.

The majority of each company's breakfast cereal offerings consisted of "less healthy" cereals, as shown in Table 5, with the exception of Weetabix, which was the only company that had a greater number of cereals falling into the "healthier" category. The companies with the highest number of "less healthy" cereals consisted of General Mills and Kellogg's (each with n = 31 "less healthy" cereals), Nature's Path Foods (n = 29), and President's Choice (n = 19). Kellogg's had the greatest number of child-targeted cereals (n = 16) followed by General Mills (n = 14), Metro (n = 6), and Nature's Path (n = 5). Jordan's, Love Grown Foods and President's Choice had no child-targeted cereals. All (100%) of the child-targeted cereals owned by General Mills, Metro, Nature's Path Foods, Post, Quaker and Sally's were classified as "less healthy."

Discussion

This study found that 85% of child-targeted breakfast cereals sold in the Ottawa-Gatineau region were "less healthy," according to the UK Nutrient Profile Model, and that these cereals were three

TABLE 1
Average nutrients per 100 g of child-targeted and not child-targeted breakfast cereals sold in Ottawa and Gatineau, Canada

	All cereals	Child-targeted	Not child-targeted	*t* test (*df*)	*p*-values
	$\bar{x}$, (SD)	$\bar{x}$, (SD)	$\bar{x}$, (SD)		
Calories (cal)	396.0 (47.5)	389.5 (21.2)	397.6 (52.0)	1.747 (206.3)	.082
Total fat (g)	6.5 (5.8)	3.6 (3.4)	7.2 (6.1)	5.593 (140.0)	.001
Saturated fat (g)	1.4 (2.0)	0.7 (1.5)	1.5 (2.0)	3.475 (102.3)	.001
Trans fat (g)	0.0 (0.1)	0.0 (0.0)	0.0 (0.1)	0.189 (260.0)	.850
Sodium (mg)	300.7 (219.3)	439.7 (217.2)	266.3 (206.2)	−5.370 (260.0)	.001
Fibre (g)	8.7 (5.7)	5.2 (3.4)	9.6 (5.9)	5.175 (260.0)	.001
Sugar (g)	21.4 (10.5)	30.2 (11.6)	19.2 (9.1)	−6.396 (67.3)	.001
Protein (g)	9.3 (3.7)	6.3 (2.0)	10.1 (3.7)	9.911 (146.8)	.001

Abbreviations: *df*, degrees of freedom; SD, standard deviation; $\bar{x}$, mean.

TABLE 2
Number and percentage of child-targeted and not child-targeted breakfast cereals classified as "healthier" and "less healthy" according to the UK Nutrient Profile Model

Healthfulness of cereals	All cereals	Child-targeted	Not child-targeted	χ^2 (*df*)	*p*-value
	n (%)	n (%)	n (%)		
"Healthier"	82 (31.3)	8 (15.4)	74 (35.2)		
"Less healthy"	180 (68.7)	44 (84.6)	136 (64.8)	7.6 (1)	.006
Total	262 (100.0)	52 (100.0)	210 (100.0)		

Abbreviation: *df*, degrees of freedom.

times more likely to be classified as "less healthy" compared to not child-targeted cereals. General Mills had the most child-targeted cereals in our sample (n = 14) and 100% of their cereals were classified as "less healthy." Kellogg's was the company responsible for the second-highest number of child-targeted cereals (n = 16) and 63% of their child-targeted cereals were classified as "less healthy." For companies such as Metro (n = 6), Nature's Path Foods (n = 5), Post (n = 3) and Sally's (n = 3), all of their child-targeted cereals were classified as "less healthy." Despite having 10 child-targeted cereals that were classified as "less healthy," Kellogg's distinguished itself by being the company that offered the greatest number of "healthier" child-targeted cereals (n = 6). The range of "healthier" cereals by breakfast cereal companies clearly needs to be extended, particularly given the fact that breakfast cereals are heavily promoted to children in other media.[16,30]

Another important finding was that child-targeted cereals were, on average, significantly higher in sugar and sodium, and lower in fibre and protein compared to not child-targeted cereals. The high sugar levels in children's breakfast cereals—30 g per 100 g of cereal on average (or 31% of energy)—is worrisome given that research has shown that sugar consumption, especially added sugars, is directly related to obesity.[31] Our research also showed that no child-targeted cereals were sugar-free, compared to 9% of not child-targeted cereals. The majority (60%) of child-targeted cereals had two to three types of added sugar, 23% of these cereals had four or more types of added sugar, and in 75% of child-targeted cereals sugar was the second ingredient. Other recent Canadian research has shown that free sugars (i.e. added and naturally occurring sugars in fruit juice) are present in 64% of all packaged products in Canada.[31] The World Health Organization recommends reducing individual intake of free sugars to 10% or less of total energy.[32] If an average 8-year-old sedentary child, whose caloric intake should be 1500 calories,[33] consumed 50 g of a child-targeted cereal, their sugar intake, based on our results, would on average be approximately 15 g of sugar (or 60 kcal), which is 40% of their total free sugars for the day. Given that breakfast cereals are only one source of added sugar in children's diets and that, in the United States, breakfast cereals are ranked as the sixth largest source of sugar for children aged 2 to 18 years after sugar-sweetened beverages, desserts (grain-based), fruit drinks, desserts (dairy-based) and candy,[34] this child would likely consume far more than the 10% sugar limit recommended by WHO. The sugar content of child-targeted cereals needs to be decreased. This could be initially accomplished by federal-level targets for processed foods. Regulations could then be developed, should industry compliance be evaluated as weak. This approach is currently being taken in the United Kingdom, where Public Health England has challenged industry to reduce sugar levels in products frequently consumed by children by at least 20% by 2020. If targets are not met, formal regulations will be considered by the government.[35] Reducing sugar in adult-targeted cereals is also recommended, as even though these cereals had a significantly lower average amount of sugar per 100 g compared to the child-targeted cereals, a large number (46%) of not child-targeted cereals in our sample contained two to three different added sugars per cereal, and 27% had four or more types of added sugar.

In 2015, when the data were collected, labelling policy with regard to sugar permitted food manufacturers to list multiple types of sugar on labels, by weight, in descending order. This policy meant that manufacturers could avoid listing sugar as the first ingredient in a food product by adding many different types of sugar and listing them separately. Health Canada has recently updated the *Food and Drug Regulations* on food labelling, and sugars must now be grouped in the ingredients list to allow consumers to more easily identify sources of sugar in food products.[22] Manufacturers have until December 2021 to group sugars together as one ingredient, for example "Ingredients: Sugars (sugar, corn syrup, fructose)." Such a policy may push cereal manufacturers to reduce the amount of sugars in their cereal, as they will likely want to avoid listing sugar as the first ingredient in their products.

Child-targeted cereals were also found to be significantly higher in sodium; on

TABLE 3
Number of sugars present in child-targeted and not child-targeted breakfast cereals sold in Ottawa and Gatineau, Canada

Number of sugars	Total cereals	Child-targeted	Not child-targeted
	n (%)	n (%)	n (%)
0	19 (7.3)	0 (0.0)	19 (9.0)
1	47 (17.9)	9 (17.3)	38 (18.1)
2–3	127 (48.5)	31 (59.6)	96 (45.7)
4–6	56 (21.4)	11 (21.2)	45 (21.4)
7–11	13 (5.0)	1 (1.9)	12 (5.7)
Total	262 (100.0)	52 (100.0)	210 (100.0)

TABLE 4
Most frequently occurring top three ingredients for child-targeted and not child-targeted breakfast cereals sold in Ottawa and Gatineau, Canada

Ingredient	Total (n = 262)			Child-targeted (n = 52)			Not child-targeted (n = 210)		
	1st n (%)	2nd n (%)	3rd n (%)	1st n (%)	2nd n (%)	3rd n (%)	1st n (%)	2nd n (%)	3rd n (%)
Sugar	8 (3.1)	116 (44.3)	93 (35.5)	2 (3.8)	39 (75.0)	17 (32.7)	6 (2.9)	77 (36.7)	76 (36.2)
Wheat	16 (6.1)	21 (8.0)	17 (6.5)	1 (1.9)	0 (0.0)	2 (3.8)	15 (7.1)	21 (10.0)	15 (7.1)
Whole wheat	49 (18.7)	27 (10.3)	3 (1.1)	14 (26.9)	1 (1.9)	0 (0.0)	35 (16.7)	26 (12.4)	3 (1.4)
Corn	30 (11.5)	24 (9.2)	17 (6.5)	16 (30.8)	8 (15.4)	10 (19.2)	14 (6.7)	16 (7.6)	7 (3.3)
Oat	102 (38.9)	16 (6.1)	18 (6.9)	10 (19.2)	1 (1.9)	6 (11.5)	92 (43.8)	15 (7.1)	12 (5.7)
Salt	0 (0.0)	0 (0.0)	15 (5.7)	0 (0.0)	0 (0.0)	6 (11.5)	0 (0.0)	0 (0.0)	9 (4.3)
Dried fruit	2 (0.8)	6 (2.3)	24 (9.2)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.0)	6 (2.9)	24 (11.4)
Oil	0 (0.0)	2 (0.8)	19 (7.3)	0 (0.0)	1 (1.9)	0 (0.0)	0 (0.0)	1 (0.5)	19 (9.0)
Rice	31 (11.8)	9 (3.4)	9 (3.4)	6 (11.5)	0 (0.0)	3 (5.8)	25 (11.9)	9 (4.3)	6 (2.9)
Nuts	0 (0.0)	0 (0.0)	6 (2.3)	0 (0.0)	0 (0.0)	2 (3.8)	0 (0.0)	0 (0.0)	4 (1.9)

average they had 440 mg of sodium per 100 g, compared to 226 mg for not child-targeted cereals. Research has shown that as children and adolescents' sodium intake increases, so does their systolic blood pressure and risk for high blood pressure.[36,37] WHO recommends reducing individual intake of sodium to 2 g per day for adults, and even less for children, depending on their energy requirements.[38]

Children's breakfast cereals were also significantly lower in fibre. On average, they contained 5 g of fibre per 100 g compared to 9 g per 100 g in not child-targeted cereals. That means if a child consumed a 50 g serving of a child-targeted cereal, they would consume only 2.6 g of fibre on average—only approximately 10% of their recommended Adequate Intake of total fibre, which ranges from 25 to 31 g per day depending on age and sex for children aged 4 to 13 years.[39] While there have been conflicting results pertaining to the specific relationship between an increased intake of dietary fibre in children and their risk of overweight or obesity,[40] some research has suggested that an increased amount of dietary fibre in children's diets is an effective means to prevent childhood obesity,[41] and children whose diets are composed of greater quantities of dietary fibre generally consume less energy from total fat, saturated fat and sucrose.[42]

As with added sugar, sodium content could be decreased, and fibre content could be increased, in breakfast cereals and in other processed foods, through federal-level targets followed by regulations that mandate change if manufacturer's compliance is poor. It is important to keep in mind, however, that food reformulation can be challenging, particularly since nutrients such as sodium, fat and sugar often play a technical role in products.[43] Salt, for instance, is a preservative that prevents spoilage, while sugar is used for texture or mouthfeel, for preservation and as a bulking agent.

Despite such challenges, the Canadian food and beverage industry has been able to positively reformulate products in the past. A recent evaluation in British Columbia has shown that trans fat use in restaurant foods has declined significantly since an initiative was launched in 2009.[44] Evidence also shows that breakfast cereal levels of sodium and sugar vary between countries, which indicates that reformulation is possible. Kellogg's Fruit Loops, for instance, has 25 g of sugar per 100 g in Kuwait, while in Mexico and Brazil this same product contains 40 g of sugar.[45]

In addition to reformulating breakfast cereals, it also recommended that regulations be developed that restrict food and beverage marketing to children on product packaging. Research conducted in Canada has shown that self-regulation of marketing through the Children's Food and Beverage Advertising Initiative (CAI) has been ineffective in television and digital advertising; children continue to view high levels of unhealthy food marketing in these media.[15-17] The failure of self-regulation has also been seen in other countries such as the United States and Australia.[46,47] Given that the CAI fails to include packaging, children are bombarded with marketing features on breakfast cereal boxes that appeal to children. The Stop Marketing to Kids Coalition, a group of over 25 large nongovernmental health- and child-related organizations under the direction of the Heart and Stroke Foundation and Childhood Obesity Foundation is advocating for the regulation of food and beverage marketing to children and youth in Canada. In its recently developed Ottawa Principles, a recommendation for policy development, the Coalition recommends restricting all food and beverage marketing to children 16 years of age and under.[48] This recommendation includes defining marketing broadly and including product packaging among other forms of marketing targeted at children. This issue was recently included in the Prime Minister's mandate letter to the Minister of Health.[49] Health Canada is also currently examining this issue, and government regulations are expected to be proposed in the fall of 2018.[50] In the fall of 2016, Bill S-228 on marketing to children was also introduced by Senator Greene Raine in the Senate.[51] This bill calls for an amendment of the *Food and Drugs Act* that would ban all unhealthy food and beverage marketing to children under the age of 17 years in all forms of media and includes product packaging. Regulation of food marketing to children would level the playing field for

TABLE 5
Number and percentage of child-targeted and not child-targeted breakfast cereals that are "healthier" and "less healthy," per company, in Ottawa and Gatineau, Canada

Company name	Total n (%)	"Healthier" n (%)	"Less healthy" n (%)
General Mills	35 (100.0)	4 (11.4)	31 (88.6)
Child-targeted	14 (100.0)	—	14 (100.0)
Not child-targeted	21 (100.0)	4 (19.0)	17 (81.0)
Jordan's (Grain Product Limited)	10 (100.0)	—	10 (100.0)
Child-targeted	—	—	—
Not Child-targeted	10 (100.0)	—	10 (100.0)
Kellogg's	48 (100.0)	17 (35.4)	31 (64.6)
Child-targeted	16 (100.0)	6 (37.5)	10 (62.5)
Not child-targeted	32 (100.0)	11 (34.4)	21 (65.6)
Love Grown Foods	9 (100.0)	2 (22.2)	7 (77.8)
Child-targeted	—	—	—
Not child-targeted	9 (100.0)	2 (22.2)	7 (77.8)
Metro	14 (100.0)	6 (42.9)	8 (57.1)
Child-targeted	6 (100.0)	—	6 (100.0)
Not child-targeted	8 (100.0)	6 (75.0)	2 (25.0)
Nature's Path Foods	45 (100.0)	16 (35.6)	29 (64.5)
Child-targeted	5 (100.0)	—	5 (100.0)
Not child-targeted	40 (100.0)	16 (40.0)	24 (60.0)
Post	14 (100.0)	5 (35.7)	9 (64.3)
Child-targeted	3 (100.0)	—	3 (100.0)
Not child-targeted	11 (100.0)	5 (45.5)	6 (54.5)
President's Choice	32 (100.0)	13 (40.6)	19 (59.4)
Child-targeted	—	—	—
Not child-targeted	32 (100.0)	13 (40.6)	19 (59.4)
Quaker (Pepsi)	10 (100.0)	2 (20.0)	8 (80.0)
Child-targeted	1 (100.0)	—	1 (100.0)
Not child-targeted	9 (100.0)	2 (22.2)	7 (77.8)
Sally's (MOM Brands Company)	9 (100.0)	1 (11.1)	8 (88.9)
Child-targeted	3 (100.0)	—	3 (100.0)
Not child-targeted	6 (100.0)	1 (16.7)	5 (83.3)
Weetabix	7 (100.0)	6 (85.7)	1 (14.3)
Child-targeted	2 (100.0)	1 (50.0)	1 (50.0)
Not child-targeted	5 (100.0)	5 (100.0)	—
Other Companies	29 (100.0)	10 (34.5)	19 (65.5)
Child-targeted	2 (100.0)	1 (50.0)	1 (50.0)
Not child-targeted	27 (100.0)	9 (33.3)	18 (66.7)
Total (%)	262 (100.0)	82 (31.3)	180 (68.7)

breakfast food manufacturers and restrict them from marketing to children on their packaging. Such a step would positively contribute to childhood obesity prevention efforts.

Strengths and limitations

This study was the first to examine a large sample of Canadian breakfast cereals and systematically categorize them based on their nutritional content and whether they were marketed to children on their product packaging. It is also the first to examine the healthfulness of breakfast cereal companies' product range. Another strength was the use of a validated nutrient profiling system, the UK Nutrient Profile Model, to classify cereals as "healthier" or "less healthy."

Weaknesses include that the cereals examined were those found in a convenience sample of the five largest grocery store chains in Canada, though efforts were made to select stores in different areas of both Ottawa and Gatineau in order to sample the full range of cereals available. Given that cereals were collected in Ottawa (Ontario) and Gatineau (Quebec), the results cannot be generalized to cereals sold in other regions of Canada; however, product lines for major cereal manufacturers are fairly consistent across the country. Future research should examine other foods targeted at children that may have poor nutritional value such as fast food, candy and snacks.

Conclusion

Given Canada's elevated rates of childhood obesity, evidence highlighting the role and impact of food marketing, and the current evidence showing that breakfast cereals targeting children are not healthy selections, the results of this study point to the importance of including product packaging in restrictions on food and beverage marketing to children. In addition, it is essential for food companies to reformulate their child-targeted breakfast cereals. Such a step could be accomplished through targets set by the federal government. By decreasing the quantity of added sugars and sodium in breakfast cereals, and increasing fibre content, Canadian breakfast cereal companies could positively influence the health of Canadian children.

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Food marketing to children in Canada: a settings-based scoping review on exposure, power and impact

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This article has been peer reviewed.

Tweet this article

Abstract

Introduction: Food marketing impacts children's food knowledge, behaviours and health. Current regulations in Canada focus on restricting promotional aspects of food marketing with little-to-no consideration of the places where children experience food. Understanding food marketing in children's everyday settings is necessary to protect children. This scoping review describes the current literature on food marketing to children in Canada by setting.

Methods: The author searched databases for Canadian research on children's exposure to food marketing, and the power and impact of food marketing to children (2-17 years) across settings, and on how current regulations may mediate the effect of food marketing on children. Peer-reviewed studies in English, published between 2000 and 2016, were included.

Results: Twenty-five studies documented children's exposure to food marketing and its power and/or impact on them in homes (via television, or online) (n = 12), public schools (n = 1), grocery stores (n = 8), fast food restaurants (n = 2), and in general (n = 2). Research trends suggest that unhealthy foods are targeted at children using multiple promotional techniques that overlap across settings. Several research gaps exist in this area, leading to an incomplete, and potentially underestimated, picture of food marketing to children in Canada. Available evidence suggests that current Canadian approaches have not reduced children's exposure to or the power of food marketing in these settings, with the exception of some positive influences from Quebec's statutory regulations.

Conclusion: The settings where children eat, buy or learn about food expose them to powerful, often unhealthy food marketing. The current evidence suggests that "place" may be an important marketing component to be included in public policy in order to broadly protect children from unhealthy food marketing. Organizations and communities can engage in settings-based health promotion interventions by developing their own marketing policies that address the promotion and place of unhealthy food and beverages.

Keywords: food marketing, childhood obesity, public health

Highlights

- Children's everyday settings are important places to restrict unhealthy food marketing.
- Research in Canada shows that children (2-17 years) are exposed to food marketing in homes, schools and supermarkets; however, overall exposure is likely underestimated.
- Powerful marketing techniques are often used in promoting less healthy foods to children.
- Multiple exposures to the marketing of unhealthy foods in various settings may adversely shape children's food culture.
- Current evidence suggests that actions by governments and communities that address all components of marketing (product, place, promotion and price) will more effectively protect children from powerful, unhealthy food marketing in their everyday settings, however more research is needed.

Introduction

Children's development takes place in their everyday settings.[1] The places where children live, learn and play are critical factors in determining their current and future health.[2] In fact, the Ottawa Charter for Health Promotion emphasizes the importance of everyday settings in preventing disease.[3] To this end, the World Health Organization recommends that the places where children gather be free from unhealthy food and beverage marketing.[4] "Place" is also a critical factor for marketers, as it is one of the four components of marketing known as the "four Ps" (4Ps): product, promotion, place and price. Corporations strategically mix the 4Ps to reach their target audience effectively and influence attitudes and behaviours.[5]

Food marketing impacts children's food knowledge, preferences, behaviours and health.[6] Factors that promote a poor diet are of concern since, according to Statistics Canada, one-quarter of the calories eaten by Canadians aged 4 to 18 years are from "other foods" (e.g. foods to be limited according to Canada's Food Guide), including soft drinks, fruit drinks, chocolate and chips.[7] More than half of children in Canada consume fewer than five servings of vegetables and fruit per day.[8] The impact of food marketing on children's food preferences and behaviours depends on their exposure to and the power of the marketing messages, where exposure is defined as "the reach

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and frequency of the marketing message," and power is "the creative content, design and execution of the marketing message."[9,p.11]

There are three main mechanisms by which food marketing to children is currently "controlled" in Canada (Table 1): (1) Quebec statutory regulation [Quebec's *Consumer Protection Act* (QCPA)[10]]; (2) food industry voluntary self-regulation [Canadian Children's Food and Beverage Advertising Initiative (CAI)[11]]; and (3) broadcast industry self-regulation (*The Broadcast Code for Advertising to Children*[12]). Additionally, in 2016, the Canadian Health Minister announced forthcoming federal statutory regulations on food marketing.[13] School food policies may also regulate food marketing to children; however, current provincial and territorial policies tend to focus on food provision and are limited and inconsistent in their address of food marketing (Table 1).

Current and proposed regulations may control both exposure to and power of food marketing to children by restricting the amount and the use of persuasive promotional techniques (discussed in the Results section of this article). Unfortunately, place, a key component of marketers' strategies[5] and of health promotion interventions,[14] is poorly considered in current approaches, with the exception of the CAI restricting some marketing in elementary schools.[15,*] It is reasonable to expect that regulations that ignore this key component of marketing will not generate maximal impact on children's exposure to or the power of food marketing. Place is often misinterpreted as the location of marketing messages, which is in fact a component of promotion.[16] A more accurate definition of place, from a marketing perspective, is the location where behaviours are performed or related goods and services are acquired.[5] In the context of food marketing, place may represent where we eat, purchase or learn about food.

Notably, the settings in which children are marketed to are a policy consideration of proposed regulations in Canada;[17] however, no research has explored what these settings are. It is critical to understand food marketing in the context in which children experience it in order to form effective policies. Using a settings-based approach,[18] this review aims to explore the places where children may be exposed to food marketing by reviewing (1) the extent of their exposure to and the power of food marketing by setting; (2) the influence of statutory (QCPA) and voluntary (CAI) regulations on exposure and power;[†] and (3) the impact of food marketing on the attitudes, perceptions and behaviours of Canadian children.

Methods

The author systematically searched eight health, psychology and business databases (Table 2) identified by a research librarian for research on the exposure to and power of food marketing to children

TABLE 1
Types of regulatory control of food marketing to children in Canada

Regulatory control	Year introduced	Location	Type	Restriction on food marketing (product)	Marketing channels and techniques covered (promotion)
Quebec *Consumer Protection Act* (QCPA)[10]	1980	Quebec	Statutory	No commercial marketing to children under 13 years.[a]	Television Radio Print media Internet Mobile phones Signs Other promotional items
Canadian Children's Food and Beverage Advertising Initiative (CAI)[15]	2007	All of Canada (except Quebec)	Voluntary self-regulation of food industry	Committed companies agree not to advertise to children under 12 years at all, or only to advertise "better-for-you" foods, as defined by a uniform nutrition criteria developed by the food industry.[19]	Television Radio Print media Internet Mobile phones Video games Movies Elementary schools Select marketing techniques (licensed characters, movie cross-promotions, celebrities, product placement)

Continued on the following page

[a] Price, another component of the 4Ps, is also not targeted in marketing regulations; however, discussion of that component is beyond the scope of this review.

[†] *The Broadcast Code for Advertising to Children* has not been evaluated by researchers; therefore, this review includes only the influence of the QCPA and the CAI.

TABLE 1 (continued)
Types of regulatory control of food marketing to children in Canada

Regulatory control	Year introduced	Location	Type	Restriction on food marketing (product)	Marketing channels and techniques covered (promotion)
The Broadcast Code for Advertising to Children[12] of the *Canadian Code of Advertising Standards*[20]	2004; 2007	All of Canada (except Quebec)	Self-regulation of broadcast media	Advertising to children under 12 years should not discourage a healthy lifestyle or adherence to Canada's Food Guide; advertising should not show excessive amounts of food being consumed or in general.	Television Radio Print media Internet Billboards
Proposed regulations on food marketing to children[17]	Forthcoming	Not disclosed	Statutory	Possible restrictions of unhealthy food marketing for select age groups (to be determined).	Possible restriction of select marketing channels, techniques, and settings (to be determined).
Provincial/territorial school food policies[b]	2008	British Columbia[21,22]	Mandatory adoption of nutrition guidelines in public schools	Discourages unhealthy food marketing.	Posters Coupons Branded equipment
	2010	Ontario[23]	Mandatory adoption of nutrition guidelines in public schools	Does not restrict food marketing.	Not applicable
	2005	New Brunswick[24,25]	Mandatory adoption of nutrition guidelines in public schools	Recommends healthy food marketing and discourages unhealthy food marketing.[c]	Rewards Incentives Vending machine promotions Fundraising
	2006	Nova Scotia[26]	Mandatory adoption of nutrition guidelines in public schools	Recommends healthy food marketing.[c,d]	Advertising (non-specific) Fundraising Rewards
	2011	Prince Edward Island[27]	Mandatory adoption of nutrition guidelines in public schools	Restricts unhealthy food marketing.[c,d]	Advertising (non-specific)
	2009	Saskatchewan[28,29]	Voluntary nutrition guidelines for mandatory school board food policies	Recommends healthy food marketing.	Rewards Fundraising
	2009	Manitoba[30,31]	Voluntary nutrition guidelines for mandatory public school food policies	Recommends healthy food marketing.[c,d]	"Daily special" promotions
	2008	Alberta[25]	Voluntary nutrition guidelines	Recommends healthy food marketing.	Posters
	2007	Quebec[29]	Voluntary nutrition guidelines	Recommends healthy food marketing.	Fundraising
	2009	Newfoundland & Labrador[32]	Voluntary nutrition guidelines	Does not restrict food marketing.	Not applicable
	2008	Yukon[33]	Voluntary nutrition guidelines	Discourages unhealthy food marketing.	Rewards Incentives Fundraising

[a] The QCPA uses three criteria to identify child-directed marketing: (1) purpose of advertised product, (2) advertisement presentation, and (3) time and place of advertisement. Advertising in schools or at point-of-purchase is not explicitly restricted by the QCPA but may be prohibited depending on these criteria.[20]

[b] There were no publicly available policies in Northwest Territories and Nunavut.

[c] Includes food pricing statements.

[d] Includes food placement statements.

TABLE 2
Scoping review of food marketing to children in Canada: systematic search criteria and process

Inclusion criteria	English language
	Canadian data
	Published between January 2000 and September 2016
	Original research
	Evidence on exposure to, power of and/or impact of food marketing to children (aged 2–17 years), or the influence of Canadian food marketing regulations
	Evidence on exposure, power and regulation must identify the setting
	Evidence on impact must clearly identify the setting, or study the collective impact of food marketing across settings
Exclusion criteria	Grey literature
	Evidence on infants and toddlers (less than age 2 years)
	Evidence on parents only
	Commentaries on policy interventions
Search string	(food OR beverage OR diet OR nutrition [TIAB]), AND (marketing OR advertis*[TIAB]), AND (child* OR youth OR teen OR adolescen*[TIAB]), AND (Canad*[TIAB]).
Databases searched	ABI/INFORM Complete, CBCA Complete, CINAHL, MEDLINE, ProQuest Dissertation and Theses, PsycINFO, Scopus, Web of Science Core

in Canada, its impact and the influence of regulations in July 2015 and updated the search in September 2016. All references were imported into an online reference manager. The author selected articles based on a priori inclusion criteria (Table 2) through systematic title, abstract and full-text screening (Figure 1). After title and abstract reviewing, three Canadian researchers with expertise in the topic area were consulted to identify missing research and confirm comprehensiveness of search results. The researchers provided 21 new items, but only four[34,37] met the inclusion criteria (Figure 1). This scoping review was limited to peer-reviewed, English-language studies using Canadian data. Two French-language articles[38,39] were excluded, as no expert fluent in French was able to review them. The author reviewed all studies and extracted the data.

Results

Twenty-five articles met the inclusion criteria (Figure 1). The literature available examined the exposure to, power of or impact of food marketing to children in Canada in general,[36,40] on television,[34,41-48] online,[49-51] in public schools,[52] on product packaging in grocery stores[35,37,53-58] and in fast food restaurants[59,60] (Table 3). The majority of articles were based on cross-sectional studies (n = 14).[34,37,42-45,49-56] Two articles reviewed the impact of the QCPA[43,44] and four reviewed that of the CAI[45-47,56] on exposure to and power of food marketing. Table 4 provides a summary of the influence of regulations on exposure and power by setting. Nine studies explored how food marketing impacted food attitudes, preferences and behaviours—three using experimental,[48,59,60] one using cross-sectional[49] and five using qualitative methods.[35,36,40,57,58]

Exposure to and power of food marketing to children in Canada

Exposure to food marketing in the home: television

Six articles reviewed exposure to television food marketing.[34,41-45] In these studies, exposure was measured by the proportion of all television advertisements that were for food (overall and unhealthy) and the rate of food advertisements per hour per channel.

One-fifth of advertisements recorded on three popular children's channels in Canada between 2007 and 2008 were for food (unpublished data by Kelly et al.[34]). Potvin Kent et al. studied the top 30 hours of television watched by ten to 12 year old children in Ontario and Quebec in 2009, which included general and children's channels, and found that 24% to 27% of the advertisements children watched were for food.[43]

The studies reported varying rates of food advertising, from three to seven advertisements per hour per channel[34,41,47] (unpublished data by Kelly et al.[34]). This variability may be related to differences in study methods, including heterogeneity in the number and type of channels recorded, times and number of days recorded and location and dates of data collection.

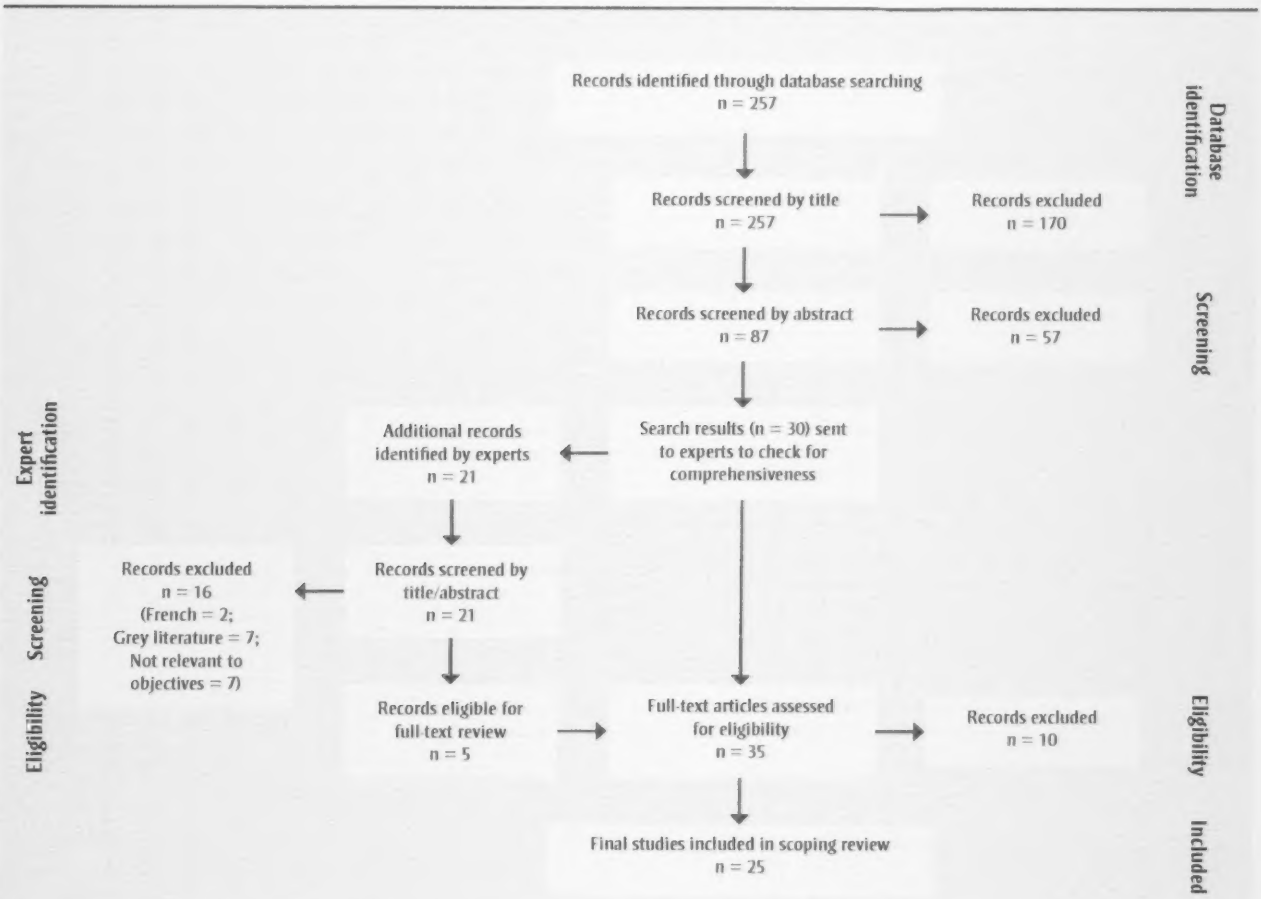
Exposure to unhealthy food television advertisements was evaluated by determining the proportion of advertised foods that were high in energy, fat, sugar or salt.[34,42,44] According to Kelly et al., 80% of food advertisements on children's channels were for "noncore foods" that were high in fat, sodium or energy.[34] Using the UK's Nutrient Profiling system, Adams et al.[42] found that 66% of all food advertisements on general television in Canada were "less healthy." Potvin Kent et al.[44] found that 88% of food advertisements watched by children in Canada were "less healthy" using the same nutrient profiling system.

Influence of regulation on exposure

Potvin Kent et al. researched the impact of statutory regulation in 2009[43] and voluntary industry regulation in 2011[46] in Canada and found that neither were associated with reduced children's exposure to television food marketing. Specifically, French-speaking children in Quebec and English-speaking children in Quebec and Ontario were found to be exposed to the same rate of food advertisements per hour per channel.[43] Potvin Kent and Wanless[47] estimated that children's overall exposure to television food advertising increased by 6% in Vancouver and 17% in Toronto between 2006 and 2011, since the introduction of the CAI. Although food advertisements on children's television from CAI companies decreased by 24% between 2006 and 2011, the same kind of advertisements by non-CAI companies increased by 76%.[46]

Small improvements in the nutritional quality of the advertised foods were associated with the QCPA[43] but not the CAI.[46] Significantly fewer advertisements watched by children were found on French-language

FIGURE 1
Flow chart of systematic search strategy



television in Quebec for "less healthy" foods than on English-language television in Ontario;[44] however, 81% of the former were still "less healthy." On the other hand, there was no significant change in the proportion of "less healthy" foods advertised by CAI companies between 2006 and 2011.[46]

Power of food marketing in the home: television

The power of food marketing is evaluated by the prevalence of child targeting in food advertisements and the use of powerful promotional techniques. On general television (from 7:00 p.m.–11:00 p.m.), 7% of food advertisements were of particular appeal to children (aged 2–17 years) in 2006.[42] On television watched by French-speaking children (10-12 years) in Quebec in 2009, only 30% of food advertisements were targeted at children, compared to 76% and 65% of advertisements watched by English-speaking children (10-12 years) in Quebec and Ontario, respectively.[43] In 2011, approximately one-quarter of food advertisements by CAI and non-CAI companies on children's specialty channels targeted children and teens.[46]

A variety of marketing techniques were used in television food advertisements, including premiums (such as giveaways, vouchers), promotional characters, fun and health appeals.[34,46] Foods advertised with these powerful techniques were often unhealthy.[34,46] For example, Kelly et al.[34] found that almost 100% of televised food advertisements that used promotional characters on children's channels in 2007 and 2008 in Canada were for "non-core" foods, compared to only 80% overall.

Influence of regulation on power

Small improvements in the power of food advertisements were found to be associated with the QCPA[43] but not the CAI.[46] In 2009, the QCPA was associated with fewer food advertisements targeted at French-speaking children in Quebec, but did not prove to fully protect all children in Quebec since English-speaking children view television originating outside Quebec, which is not restricted by Quebec's law.[43] Overall, there was no change in the prevalence of targeting children in food advertisements by CAI or non-CAI companies between 2006 and 2011.[46] In fact, there is some evidence that it has worsened, since more unhealthy food advertisements targeted children in 2011 than 2006.[46] For example, between 2006 and 2011 the use of fun and licensed characters to advertise "less healthy" products increased by 38% and 234% by CAI companies, respectively.[46]

TABLE 3
Synthesis of Canadian, English-language literature on exposure to and the power and impact of food marketing to children in Canada, and the influence of the QCPA and the CAI

Author	Setting	Population; location	Design	Purpose	Data Collection Period	Overview of methods	Key outcome measures	Key results
Kelly et al., 2010 [34]	Home: TV	Children's TV; Alberta, Ontario	Cross-sectional	Identify frequency, nutritional quality and persuasive techniques used in food advertising on children's TV channels in 11 countries	Oct. 2007–Mar. 2008	Recorded all ads on 3 most popular children's TV channels for 2 weekdays and 2 weekend days from 6:00–22:00. Food ads were coded for promotional techniques and nutritional quality (core, noncore or miscellaneous). X^2 tests compared country-level differences.	Number and rate of food advertising; proportion of food ads by program type, product type and nutritional quality; proportion of food ads with persuasive techniques	In Canada, one-fifth of ads were for food, the second-most advertised product. (E) Overall, food advertising was 4–7 ads/hr/channel and was higher on weekends. 80% of ads were for noncore foods. Fast food most commonly advertised. (E) Canada had one of the lowest proportions of food ads with premium offers (0–4%) but had the second-highest proportion of food ads with promotional characters (33–36%), of which almost all were for noncore foods. (P)
Adams et al., 2009[42]	Home: TV	General TV; Ontario, Quebec	Cross-sectional	Compare frequency, nutritional quality of food advertising on children's TV in Canada and the UK prior to introduction of UK regulations	30 Oct. 2006–5 Nov., 2006	Recorded all ads on 4 free viewing channels (24h/d). Ads were coded as "of particular appeal to (OPAT) children" [42, p.652] if >20% of viewing population were children. UK Food Standards Agency definition used to identify "less healthy" food ads. Fisher exact tests used to compare OPAT children and non-OPAT children groups.	Number and rate of food ads; proportion of food ads OPAT children; nutritional quality of food ads	In Canada, 2315 food ads were identified from 4 channels over 7 days. (E) 7% of ads were OPAT children (defined as 2–17 years in Canada). (P) 66% of food ads were for "less healthy" foods. (E) No significant differences between proportion of "less healthy" food ads that were OPAT children compared to ads not OPAT children in Canada ($p = .15$). (P) No significant differences in product type advertised between OPAT-children ads and non-OPAT-children ads were found in Canada, except for sweets and candy, which were advertised less often to children. (P)
Adams, et al., 2009[41]	Home: TV	General TV; Ontario, Quebec	Longitudinal	Compare frequency, nutritional quality of food ads on prime time TV from 1991–2006 in Canada and the UK	26 Oct. 1991–1 Nov. 1991; 30 Oct. 2006–5 Nov. 2006	Recorded ads on 5 and 4 free channels in 1991 and 2006, respectively, from 19:00–22:59. Food ads were coded for food type and promotional technique. "TV diets" were generated by summing one serving of each food advertised and were compared to reported diets from national surveys. X^2 tests compared outcomes within and across countries.	Number and rate of food ads; product type and nutritional quality of food ads	No change in rate of TV food advertising from 1991–2006 (5/h) in Canada. (E) Fast food product and restaurant ads significantly increased five-fold in Canada and were the most commonly advertised items at 29.5% and 15.6% of food ads. Fruits, vegetables and juices significantly decreased from 8% of ads to 2% in Canada. (E) TV diets from 1991 and 2006 were similar, but 2006 had less energy from alcohol. The 1991 and 2006 TV diets contained less fibre and energy from protein than reported intakes. The 2006 TV diet had greater levels of energy from sugar and higher sodium levels than reported intakes in 2006. (E)
Potvin Kent et al., 2011 [43]	Home: TV	TV viewed by English- and French-speaking children aged 10–12 yrs; Ontario, Quebec	Cross-sectional	Compare frequency of food marketing on children's preferred TV in two Canadian provinces	26 Mar. 2009–1 Apr. 2009	Recorded 90 hours of TV watched from 6:00–0:00 by 428 children over one week. Ads were coded by day/time, program type, station, ad type/length, food type and target audience. X^2 tests compared differences between French-speaking children in Quebec, English-speaking children in Quebec and English-speaking children in Ontario.	Number and rate of food ads; characteristics of ads by station, channel and time; type of food advertised; type of promotion used	Neither the number of food ads nor the rate of TV food advertising (3–5/h) differed significantly between groups ($p < .06$). (IR-E) More food ads targeted preschoolers ($p < .001$), children ($p < .001$) and teenagers ($p < .03$) in the English-speaking groups compared to the French-speaking group. (IR-P) More ads were for snacks/candy and grain products in English-speaking groups compared to the French-speaking group. (IR-E) Significantly more persuasive marketing techniques (fun appeal, characters/celebrities, contests) were seen by English-speaking groups compared to French-speaking group. (IR-P)

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TABLE 3 (continued)
Synthesis of Canadian, English-language literature on exposure to and the power and impact of food marketing to children in Canada, and the influence of the QCPA and the CAI

Author	Setting	Population; location	Design	Purpose	Data Collection Period	Overview of methods	Key outcome measures	Key results
Potvin Kent et al., 2012 [44]	Home: TV	TV viewed by English- and French-speaking children aged 10–12 yrs; Ontario, Quebec	Cross-sectional	Compare nutritional quality of foods advertised on children's preferred TV in two Canadian provinces	26 Mar. 2009–1 Apr. 2009	Recorded 90 hours of TV watched from 6:00–0:00 by 428 children over 1 week. Nutritional quality of foods advertised was assessed by a 100 g reference size and classified as high in fats, sugar or sodium and/or low in fibre, and identified as "less healthy" using the UK Food Standards Agency definition. One-way ANOVA with post hoc tests compared group differences.[42]	Mean nutrients per 100 g advertised; percentage energy from energy, fats, carbohydrates; proportion of high-sugar/fat/salt, low-fibre food ads; proportion of "less healthy" food ads	English- and French-language food ads significantly differed in macronutrient content: French higher in total fat, saturated fat, trans fat; lower in carbohydrates, sugar, energy than English groups ($p < .001$). (IR-E) Statistically significantly more English ads were for "less healthy" (68.3-68.9%) foods than French ads (60.6%) ($p < .001$).(IR-E)
Potvin Kent et al., 2011 [45]	Home: TV	TV viewed by English- and French-speaking children aged 10–12 yrs; Ontario, Quebec	Cross-sectional	Compare presence of food marketing to children on children's preferred TV by companies committed and not committed to CAI	26 Mar. 2009–1 Apr. 2009	Recorded 99.5 hours of TV watched from 6:00–0:00 by 272 children over 1 week. Ads were coded by food type, use of media characters and whether the ad was from a CAI or non-CAI company. Nutritional quality was assessed by 100 g reference size, and using the UK Food Standards Agency definition for "less healthy" foods. X^2 tests and t tests compared differences between CAI and non-CAI ads.	Number of food promotions; type of food products promoted; proportion of use of media characters; proportion of "less healthy" products	24% (n = 418) of all ads recorded were for foods or beverages. (E) Food companies committed to CAI provided 63% of all ads recorded. (IR-E) Ads by CAI companies had significantly more energy, fats, sugar and sodium ($p < .001$). (E) Significantly more ads by CAI companies were considered "less healthy" than non-CAI companies ($p = .001$). (IR-E) CAI ads used media characters more often ($p < .001$) and were significantly more likely to promote "less healthy" products with media characters ($p < .001$) than non-CAI. (IR-P)
Potvin Kent et al., 2014 [46]	Home: TV	Children's specialty TV; British Columbia, Ontario	Longitudinal	Compare frequency, nutritional quality of food marketing on children's TV from 2006–2011 by companies committed and not committed to voluntary industry regulation (CAI)	May 2006; May 2011	4 weeks of food ads for 11 food categories aired from 6:00–0:00 on two children's specialty channels were purchased from Nielsen Media Research for two time periods. Ads were coded for target audience, use of persuasive marketing techniques and food company commitment to the CAI in 2011. Nutritional content was assessed by 100 g reference size, and using the UK Food Standards Agency definition for "less healthy" foods. t tests compared mean group differences.	Mean nutrient content; proportion "less healthy"; proportion targeting children, teens and adults; proportion using persuasive marketing techniques	Proportion of food ads by CAI companies decreased by 24% and that of non-CAI companies increased by 76% from 2006 to 2011. (IR-E) No change in proportion of CAI ads considered "less healthy" ($p = .235$). (IR-E) Significant decrease in proportion of non-CAI ads considered "less healthy" ($p < .001$). (IR-E) Increased targeting of "less healthy" ads to children and teens by CAI companies in 2011 over 2006. (IR-P) Increased use of fun appeals and characters by CIA companies in 2011 over 2006. (IR-P)
Potvin Kent & Wanless, 2014[47]	Home: TV	Children's specialty TV and general TV viewed by children aged 2–11 yrs; British Columbia, Ontario	Longitudinal	Compare changes in children's exposure to food marketing on TV between 2006 and 2011	May 2006; May 2009; May 2011	4 weeks of food ads for 11 food categories aired between 6:00-0:00 on 27 channels (2 children specialty channels and 25 general channels) were purchased from Nielsen Media Research for three time periods. Children's exposure levels to food ads were estimated and compared across time periods.	Number and rate of food ads; children's overall average exposure to food advertising	Number and rate of food ads increased between 2006 and 2011. (IR-E) There was a decrease in food ads on children's channels (5%) but a 44%–45% increase on general channels between 2006 and 2011. (IR-E) Overall exposure increased by 6%–17% between 2006 and 2009. (IR-E) Children's exposure to candy and cereal ads was mostly from children's specialty channels but ads for chocolate, juice, diet soft drinks and fast food came from general TV. (IR-E)

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TABLE 3 (continued)
Synthesis of Canadian, English-language literature on exposure to and the power and impact of food marketing to children in Canada, and the influence of the QCPA and the CAI

Author	Setting	Population; location	Design	Purpose	Data Collection Period	Overview of methods	Key outcome measures	Key results
Hudson & Elliott, 2013[36]	Home: TV	Children aged 7–12 yrs; Canada	Experimental	Assess the impact of TV product placement on snack behaviour in children	Not stated	225 children were randomly assigned to view a 20-min children's TV program with healthy, unhealthy, or no product placement. After viewing, children recalled brands, sponsors or advertising messages in the program, and chose a food and beverage from a set selection. Questionnaires were used to record children's experiences of the show. Logistic regression tested the predictive ability of multiple variables, including recall of product placement, on snack behaviour.	Recall of product placement; immediate choice of food and beverage; impact of other variables on relationship between product placement and behaviour (TV viewing habits, how much children liked the TV program and products)	Children were unaware of product placement as a marketing technique. (I) Children (especially aged 10–12 yrs) who viewed an unhealthy product placement in a TV program had better recall of products. (I) There was a modest but mixed impact on snack choice immediately after viewing. Pepsi or Coke and Fruit Gushers were most popular regardless of the experimental group, which may be due to children selecting "treats" during the experiment. (I) Strongest predictors of snack choice were whether the child liked the product packaging, and whether the product looked fun or "yummy."[40,p.197] (I)
Brady et al., 2010[10]	Home: online	Websites of CAI companies with marketing targeted at children aged 6-12 yrs; Canada	Cross-sectional	Compare marketing to children on the websites of CAI companies	Not stated	24 websites of CAI companies were identified and evaluated for 379 items related to the presence and type of online marketing techniques. Five marketing objectives were evaluated: target market appeal, increased engagement, increased awareness of the brand and websites, increased brand engagement, and influencing children's brand preferences and consumption norms.	Proportion of websites targeting children; number of marketing objectives, techniques and strategies observed on websites	83% of websites targeted children under age 12 yrs. (P) Websites commonly encouraged prolonged engagement through free memberships (63%), high-score leader boards (50%) and game rewards (46%). Interaction with product/brand was promoted though "advergames," music, sounds, animation and buttons (88%). (P) Half encouraged sharing brand or website with friends. The majority of websites had material that could be downloaded by children for use in their everyday lives, such as screensavers, wallpaper, placemats and growth charts. (P) Foods advertised were similar to those advertised on TV and were inconsistent with Canada's Food Guide. (E) One-third provided nutrient information, 21% claimed health benefits and 42% promoted physical activity. (P)
Potvin Kent et al., 2013[51]	Home: online	Restaurant websites; Canada	Cross-sectional	Compare content of English-Canadian and French-Canadian food company websites, and websites by CAI and non-CAI companies	Spring 2010	77 English-Canadian and 70 French-Canadian restaurant websites, identified from food ads on children's preferred TV,[44] were analyzed for child-directed content. Websites with child content were coded for marketing features, child protection features and health promotion messages. X^2 and t tests compared group differences between English and French websites, and between CAI and non-CAI websites.	Frequency of marketing techniques, child protection features, and healthy living messages	Frequency of child-directed content was not statistically different between French and English sites ($p < .640$), nor between CAI and non-CAI websites ($p < .877$). (IR-P) No significant difference in the proportion of marketing to children or online marketing techniques between English- and French-Canadian food company websites, nor between CAI and non-CAI company websites. (IR-P) French websites had more healthy living messages but this was not statistically significant. (IR-P) Non-CAI companies used no child-protective features while 14.3%–28.6% of CAI companies did. CAI companies were also more likely to promote healthy living. (IR-P)

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TABLE 3 (continued)
Synthesis of Canadian, English-language literature on exposure to and the power and impact of food marketing to children in Canada, and the influence of the QCPA and the CAI

Author	Setting	Population; location	Design	Purpose	Data Collection Period	Overview of methods	Key outcome measures	Key results
Brady et al., 2008[49]	Home: online	Children aged 7–13 yrs; Canada	Cross-sectional	Explore children's awareness and use of online food marketing features and its impact on food requests	Jul. 2007–Aug. 2007	A convenience sample of 83 children at a summer day camp was recruited and completed an interview and questionnaire on the awareness and engagement with online marketing and relationships with requesting foods.	Prevalence of engagement with online marketing; prevalence of requests, purchases of food advertised online	Significantly fewer children (68%) believed there was food marketing on the internet compared to TV (99%) ($p < .001$). (I) Over one-third visited food company websites advertised on TV or on product packaging (I) 13% shared these websites with friends.(I) 35% wanted to try a food advertised online and 21% requested or purchased the product. (I) Soft drinks, chocolate and candy were the top foods children wanted to try. (I)
Velazquez et al., 2015[52]	School	Public schools; British Columbia	Cross-sectional	Identify frequency and type of food marketing in public schools in Vancouver	Nov. 2012–Apr. 2013	Observational audit of food promotions in common areas of 23 public schools. Promotions were coded by location, size, advertised product/brand, ad purpose, marketing techniques, and healthfulness as per provincial nutrition guidelines. X^2 and Fisher exact tests compared school group differences.	Number of food promotions; frequency of product type advertised, presence of marketing type, and provincial nutrition category	87% of schools contained food marketing (median 17/school, range 0–57/school), with more in secondary schools than elementary ($p < .01$). (E) 60% of promotions were located in schools' hallways. (E) 55% of schools promoted "prohibited" foods and beverages according to the provincial guidelines. Only 13% of promotions were nutrition education. (E) Products and brands were promoted in 18% and 26% of promotions, respectively; characters and premium offers were rare (3% and 4% of promotions, respectively) (P)
Berry & McMullen, 2008[53]	Grocery store	Breakfast cereals at eye level of children aged 8 yrs or younger in Canadian supermarkets; Ontario	Cross-sectional	Explore associations between marketing techniques and nutritional quality of breakfast cereals	Mar. 2005–Nov. 2005	Recorded breakfast cereals in a representative sample of 15 grocery stores that were 0–48 inches off ground. Product packaging was coded for marketing features. Nutritional content and ingredients were recorded. Multivariate regression using marketing features as predictors and nutritional content as outcomes was used to determine whether the cereal aisle is "health-protective" or "health-exploitive"[53,p.333]	Frequency of marketing features (spokes-characters, colours, child-orientation, reachable by child, oversized box); sugar, whole grain and trans fat content; relationship between features and nutrition	2755 cereal boxes identified at children's height. (E) Spokes-characters, colourful packaging, and child-oriented incentives were found on 34%, 48% and 35% breakfast cereal shelf space, respectively. (P) 17% of cereals were in child-themed colours and/or shapes (P) Cereals with these marketing techniques were also significantly higher in sugar, refined grain and/or trans fat. (P) Boxes that could be reached by children had mixed results on nutritional content (no difference in sugar, but more likely to have whole grain and less trans fat). (P)
Elliott, 2008[54]	Grocery store	Regular (non-junk) foods targeted to children in Canadian supermarkets; location not provided	Cross-sectional	Assess the nutritional quality of foods marketed to children in Canadian grocery stores	Dec. 2005	367 foods targeted to children ("fun foods"[54,p.359]) were purchased from Loblaws Superstore and coded for 36 variables related to the food type and packaging marketing features (graphics, nutrition claims). "Poor nutritional quality" products were identified using US Center for Science in the Public Interest benchmarks. X^2, phi and Cramer's V tests assessed group differences.	Frequency of food types by nutritional quality; frequency of marketing techniques; differences by groups (food type, nutrient quality, presence of marketing technique)	Dry goods (cereal, crackers, cookies, granola bars, etc.) were the most common "fun foods" (61%). Vegetables and fruit were only 1% of the "fun foods". (E) 89% of "fun foods" were high in fat, sugar, or sodium. Acceptable cut-offs for sugar content were most frequently violated, at 70% of products. Total fat and sodium cut-offs were violated in 23% and 17% of products. (E,P) Products high in fat, sugar or sodium were significantly more likely to have a front-of-pack nutrition claim ($p < .001$) (P)

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TABLE 3 (continued)

Synthesis of Canadian, English-language literature on exposure to and the power and impact of food marketing to children in Canada, and the influence of the QCPA and the CAI

Author	Setting	Population; location	Design	Purpose	Data Collection Period	Overview of methods	Key outcome measures	Key results
Elliott, 2012[55]	Grocery store	Regular (non-junk) foods targeted to children in Canadian supermarkets; Alberta	Cross-sectional	Identify regular grocery foods marketed to children in Canadian grocery stores	2009	354 foods targeted to children ("fun foods"[55,p.305]) were purchased from The Real Canadian Superstore and Safeway and coded for 37 variables related to food type, packaging marketing features, target audience and nutritional quality. X^2, phi and Cramer's V tests assessed group differences.	Frequency of child-targeting product packaging and relationships between food types, packaging characteristics, target audience, nutritional quality	The majority of "fun foods" were dry goods (64%), only 1% were fruits or vegetables. (E) Parents were targeted on 55% of products. (P) Marketing techniques included: colours, shapes, cartoons, highlighting "fun food,"[55,p.305] nutrition claims, small portion sizes and convenient packaging. (P)
Elliott, 2012[37]	Grocery store	Regular (non-junk) packaged foods targeted to children in Canadian supermarkets; Alberta	Cross-sectional	Compare nutritional quality of "regular" and "better-for-you" foods marketed to children in Canadian grocery stores	2009	354 foods targeted to children ("fun foods"[37,p.267]) were purchased from The Real Canadian Superstore and Safeway and coded for 37 variables related to food type and packaging marketing features, including claims that the product is healthier or "better-for-you."[37,p.268] "Poor nutritional quality" products were identified using US Center for Science in the Public Interest benchmarks. X^2 and Fisher exact tests were used to assess group differences.	Frequency of healthier or "better-for-you" products; nutritional quality	23% of foods marketed to children ("fun foods") were considered "better-for-you" as per its packaging. (E,P) Overall, a lower proportion of "better-for-you" foods were high in fat, sugar or sodium than regular foods (65% vs. 91%, respectively). However, when considering the fixed effects of dry goods, there is no statistically significant difference in the proportion of regular and "better-for-you" foods that are of poor nutritional quality. (P) Almost all "better-for-you" foods that were high in fat, sugar or sodium had a front-of-pack nutrition claim. More "better-for-you" foods were marketed as "fun." (P)
Murray, 2014[56]	Grocery store	Packaged foods and beverages; Canada; specific location not provided	Cross-sectional	Assess the presence of foods with product packaging marketed to children, and their nutritional quality	2010–2011	10 488 packaged food labels in Canadian grocers from Food Label Information Program 2010 were assessed for product packaging marketing to children aged 2–13 yrs from CAI and non-CAI companies. The UK Food Standards Agency definition was used to identify ads for "less healthy" foods. Wilcoxon rank sum test compared nutrient levels and X^2 or Fisher exact tests examined group differences.	Frequency and proportion of foods marketed to children; nutritional quality	415 packaged foods (4%) were marketed to children. (E) The products most frequently marketed to children were baked goods, desserts, cereals/ grain products, snacks and combination dishes. (E) Graphics, lettering, characters and unusual flavours, shapes and colours were most common marketing techniques used. (P) There were mixed results of nutrient content differences between foods marketed and not marketed to children. (E) 81% of the foods and beverages marketed to children were considered "less healthy". (E) There was no significant difference in the nutritional quality of foods marketed to children by CAI companies and by non-CAI companies (p = .090). (IR-E)
Elliott & Brierley, 2012[50]	Grocery store	Children aged 5–12 yrs; Alberta, Ontario, New Brunswick	Qualitative	Explore how children identify healthy products using packaging	2009	225 children participated in 52 focus groups divided by gender and age. Children were asked to evaluate the healthfulness of foods by looking at their packaging. Grounded theory approach was used for data analysis.	Identify the features of product packaging used by children to evaluate foods healthfulness	Ingredient lists and nutrition facts tables were used less frequently than front-of-pack claims. The children provided only vague explanations of how they used nutrition information to decide on a healthy product.(I) Colours, spokes-characters, language and pictures influenced perceptions of healthfulness. (I) Children believed products with bright, multiple colours were less healthy than muted colours; green was healthy. Pictures of foods not included in the package (i.e. strawberries in cereal) were often used in the analysis of products' healthfulness. (I) Spokes-characters were reported to be associated with both healthy and unhealthy products. (I)

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TABLE 3 (continued)
Synthesis of Canadian, English-language literature on exposure to and the power and impact of food marketing to children in Canada, and the influence of the QCPA and the CAI

Author	Setting	Population; location	Design	Purpose	Data Collection Period	Overview of methods	Key outcome measures	Key results
Elliott, 2009[57]	Grocery store	Children aged 5–12 yrs; Ontario	Qualitative	Explore children's understanding, responses, and perceptions of packaged foods	Feb. 2007	36 children participated in 6 focus groups divided by gender and grade to explore children's preferences, perceptions of food and process of assessing nutrition and health of food. Children participated in several activities: drawing and rationalizing their favourite dinner meal; individually selecting most appealing foods from multiple standard selections of products; identifying and rationalizing healthy products. Grounded theory approach was used for data analysis.	Understanding of and response to child-targeted food packaging; understanding of how children identify healthy food products, differences by age and gender	Younger grades preferred foods with unusual shapes/colours and cross-merchandising, whereas older grades chose foods based on appealing or appetizing packages. (I) Fun was an important feature in food choice across all ages. (I) Boys appeared to select products that they could play with; girls appeared to select products that were "pretty" [57,p.369] or that they personally related to. (I) Ingredient lists, front-of-pack packaging (colours, package seriousness) and labelling were "clues" [57,p.371] used to decide if a product was healthy; however, their interpretation was not usually accurate. Many children were unaware of nutrition facts tables. (I)
Brierley & Elliott, 2015[35]	Grocery store	Children aged 5–12 yrs; Alberta	Qualitative	Explore boys' interpretations of "healthy" and "less healthy" packaged foods	Not stated	58 children (27 boys) from a high socioeconomic school participated in 12 focus groups divided by age and gender to explore interpretations of "healthy" and "less healthy" foods. Children participated in two activities: individually identifying the "healthiest" and "less healthy" crackers, cookies, yogurt from a selection; sorting cereals into "healthy" and "less healthy" as a group. Descriptive and topic coding were used for data analysis.	Understanding of how boys classify packaged food as "healthy" and "less healthy"	Discussions in focus groups with boys revolved around using nutrition facts tables to decide whether a food was healthy. (I) Boys focussed more on the foods' content of calories, fat, sugar and salt than girls did in deciding whether a food was healthy, and often made reference in discussions to being healthy, having a healthy weight, or playing sports. (I) Boys felt that foods besides vegetables and fruit were healthy, as well as food that were "protein," "meaty," "seed." [35,p.30] (I) "Organic" was often used by both genders to identify a healthy food.[35,p.31] (I)
Hobin et al., 2012[59]	Fast food outlet	Children aged 6–12 yrs; Ontario	Experimental	Compare impact of toy premiums on healthy fast food meal selection in children aged 6–12 yrs	Jul. 2011–Aug. 2011	A convenience sample of 337 children at a summer day camp was recruited and randomly allocated to choose their lunch from an intervention menu (2 healthy meals with toys and 2 less healthy meals without toys) or a control menu (all 4 meals, healthy and less healthy, with toys). X^2 tests compared group level differences. Logistic regression tested group differences controlling for age and gender.	Proportion of children who selected the healthy meal vs. the less healthy meal	Children who were offered a toy only with the healthy meal were significantly more likely to pick the healthy meal (OR = 3.19, 95% CI: 1.89–5.40). (I,P) Girls were more likely to select the healthy meal (OR = 1.19, 95% CI: 1.14-3.17, p =.01), but there was a significant two-way interaction between the intervention and gender (X^2 = 0.433, p = .038): "pairing toys with healthier meal options had a stronger effect on boys compared to girls."[59,p.e206] Only 10.0% of boys in the control selected the healthy option, increasing to 37.3% in the intervention; 27.5% of girls in the control selected the healthy option, compared to 41.2% in the intervention. (I)

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TABLE 3 (continued)

Synthesis of Canadian, English-language literature on exposure to and the power and impact of food marketing to children in Canada, and the influence of the QCPA and the CAI

Author	Setting	Population; location	Design	Purpose	Data Collection Period	Overview of methods	Key outcome measures	Key results
Elliott et al., 2013[60]	Fast food outlet	Children aged 3–5 yrs; Alberta	Experimental	Compare impact of branding and colourful packaging on taste preferences children aged 3–5 yrs	Not stated	77 children were randomly given identical foods in two different packages. Children selected their preferred food from their two options. Parents completed a questionnaire on child demographics, TV habits, eating habits and income. Wilcoxon signed rank, Mann-Whitney U and Kruskal-Wallis tests examined experimental impact and relationship with child characteristics.	Child preferred food; child characteristics; impact of packaging on food choice	Children preferred food that was presented in McDonald's packaging compared to plain packaging ($p < .009$), but not compared to coloured ($p < .240$) or Starbucks packaging ($p < .404$). (I,P) Carrots in McDonald's packaging were believed to be tastier than those in plain packaging ($p = .0497$) but not as tasty as carrots in coloured packaging ($p = .033$). (I,P) Taste did not differ for any other product (burger, nuggets, dessert), except fries, which were reported as tastier in McDonald's than plain packaging ($p = .048$). (I,P) Frequency of visiting McDonald's impacted taste preferences in the McDonald's vs. plain packaging group only ($p < .044$). (I,P)
Elliot, 2011[80]	n/a	Children aged 6–11 yrs; Alberta, Ontario, New Brunswick	Qualitative	Explore how children perceive food for them and food for adults	Not stated	225 children were recruited for focus groups to explore food preferences, food categories ("kids' food," "adult food"[80,p.127]), and nutrition. Focus groups contained 4–6 children and were separated by gender and grade level. Grounded theory approach was used for data analysis.	Perceptions of food types, preferences, and nutrition	Children's views were consistent across age, gender and location. (I) Children viewed "kids' food" as unhealthy junk food that might be presented in an unusual shape or colour or in a small serving, or that could be played with. (I) Adult food was perceived to be healthy, plain and responsible, such as salad or protein. (I) Children's beliefs about "kids' food" and "adult food" categories did not differ by age or gender. (I)
Elliot, 2014[86]	n/a	Children aged 12–14 yrs; location not provided	Qualitative	Explore how adolescents perceive non-branded food items	Spring 2013	5 focus groups of 6 adolescents each, separated by gender and grade level, were used to explore the meaning of food to adolescents through the topic of "food as people."[86,p.85] Grounded theory approach was used for data analysis.	Perceptions of personality traits of non-branded foods	Adolescents reported socially constructed perspectives on several food categories (broccoli, milk, meat, eggs, junk food, organic food) that do not have specific marketing campaigns. (I) For some food types, girls and boys had differing perspectives: girls believed milk to be healthy and athletic, while older boys believed it to be less desirable; girls assigned negative attributes to meat but boys assigned positive attributes to it. (I) Adolescents generate consistent "brand personalities" regardless of whether a food is commercially branded or promoted.(I)

Abbreviations: ad(s), advertisement(s); ANOVA, analysis of variance; CAI, Canadian Children's Food and Beverage Advertising Initiative; CI, confidence interval; d, day; E, exposure; h, hour; I, impact; IR-E, influence of regulation on exposure; IR-P, influence of regulation on power; min, minute; OPAT, of particular appeal to; P, power; QCPA, *Quebec Consumer Protection Act*; TV, television; X^2, chi-square; yr(s), year(s).

TABLE 4
Summary of influence of current regulation in Canada on exposure to and power of food marketing to children by setting

Setting	Influence of QCPA			Influence of CAI		
	Exposure[a] to food marketing overall	Exposure[a] to unhealthy food marketing	Power[b]	Exposure[a] to food marketing overall	Exposure[a] to unhealthy food marketing	Power[b]
Home (TV)	No influence	Positive influence	Positive influence	Negative influence	No influence	Negative influence
Home (online)	—	—	No influence	—	—	No influence
School	—	—	—	—	—	—
Supermarket	—	—	—	—	No influence	—

Abbreviations: CAI, Canadian Children's Food and Beverage Advertising Initiative; QCPA, *Quebec Consumer Protection Act*; "—", not documented.
[a] Exposure is defined as "the reach and frequency of the marketing message."[3,p.11]
[b] Power is defined as "the creative content, design and execution of the marketing message."[3,p.11]

Exposure to food marketing in the home: online
Online food marketing in Canada was captured by two studies evaluating marketing to children on food company websites.[50,51] This evidence does not assess the multitude of emerging electronic marketing techniques used to target children, including viral marketing (online word-of-mouth by consumers), social networking and direct marketing by e-mail.[4] The author found no studies that assessed these techniques in Canada. Studies from other countries may be informative, since Canadians can access international websites; however, that was beyond the scope of this review. The two included studies focussed on documenting the powerful characteristics of food company websites and were not designed to measure exposure—for example, the proportion of websites visited by children with food marketing. Thus, the available evidence does not reveal children's exposure to food marketing online, or the impact of regulation on the degree of exposure.

Power of food marketing in the home: online
In 2010, Potvin Kent et al.[51] reviewed websites tied to food or beverages advertised on television watched by ten to 12 year old children to evaluate the impact of the QCPA and the CAI. Of 148 websites, approximately one-third were child-directed, which was defined as having "child-oriented marketing features such as spokes-characters, cartoons, contests, activities, or games directed at children; and [using] simple vocabulary easily understood by children."[51,p.801] In a separate evaluation of only CAI company websites, 83% contained marketing directed at children under 12 years of age.[50]

Multiple techniques urged children to engage with the food marketing on CAI websites:[50]

- memberships, incentives and leaderboards for repeated and prolonged use of online media;
- "advergames," music, animation and e-buttons to interact with the product or brand;
- electronic word-of-mouth techniques to share brand or website information; and
- downloadable features (computer wallpaper, growth charts, shopping lists, board games) to embed brands into children's daily lives.

Influence of regulation on power
No statistical differences in the power of food marketing (e.g., whether or not they targeted children, the type or frequency of promotional techniques used) were found between French- and English-language websites, nor between CAI and non-CAI websites in 2010.[51]

Exposure to food marketing in schools
With only one study on marketing in schools conducted in the last decade,[52] evidence is lacking in this setting. Velazquez et al.[52] examined the extent of commercial and non-commercial (made by the school or students) food promotions in a representative sample of 23 Vancouver public schools in the 2012/13 school year. Through observation, Velazquez et al.[52] found that 87% of schools displayed food promotions. Schools had a median of 17 promotions (range = 0–57). Secondary schools had more advertising than elementary schools.[52]

Velazquez et al.[52] used British Columbia's school nutrition guidelines[21] to assess the healthfulness of observed food and beverage promotions. Over half of schools promoted foods or beverages prohibited by the provincial guidelines.[52] Almost one-quarter of all promotions were for "Choose Least Often" or "Not Recommended" items.[52] On the other hand, 80% of the schools had promotions for "Choose Most Often" items, which made up 45% of all promotions.

Influence of regulation on exposure
No studies have evaluated the impact of the QCPA or the CAI on exposure to food marketing in schools. The lower levels of food marketing in elementary schools documented by Velazquez et al.,[52] a setting partially covered by the CAI, may reflect the influence of the CAI; however, this finding more likely reflects the fact that secondary schools have more food services (vending machines and concessions) than elementary schools[52] and thus more food promotion.

Power of food marketing in schools
Velazquez et al.[52] found that observable food promotions in schools often involved specific products or brands, and rarely used animated characters, celebrities or premium offers. The rare use of these powerful techniques may be related to the finding that half of promotions recorded were noncommercial promotions created by the students or the school.[52]

Influence of regulation on power
Not documented.

Exposure to food marketing in supermarkets
Two studies documented the proportion of products that targeted children through

product packaging. From 15 randomly audited grocery stores in Ontario, Berry and McMullen found 2755 cereal boxes at child height (defined as 48 inches from the ground, which takes into account the eye level of a child sitting in a shopping cart as well as standing or walking).[53] Up to half of breakfast cereal shelf space at child height contained cereal boxes with at least one child-directed feature (described in the "Power of food marketing in supermarkets" section of this article). From the University of Toronto's Food Label Information Program database, which contains over 10 000 packaged food products collected between 2010 and 2011, Murray found that 415 (4%) targeted children, defined as depicting fun or play, or using cartoons or child-like fonts.[56] One other study[55] identified products that were targeted to children only, without collecting a total product denominator. In two supermarkets in Alberta, Elliott found over 350 everyday foods (not junk foods) that targeted children, defined as being designed for children, or displaying cartoons, cross-merchandising, unusual shapes, colours, tastes, or games on its packaging.[55] The estimates of exposure in these three studies are not complete; true exposure may be underestimated, since none of the studies explored food marketing in checkout areas, store display, or other features of grocery stores.

Overall, most foods marketed to children in supermarkets were high in sugar, fat or sodium[54] and/or low in desirable nutrients.[56] Almost one-quarter of foods marketed to children were labelled "better for you" according to the CAI definition; however, two-thirds of the "better for you" foods were still high in sugar, fat or sodium.[37] A significantly greater proportion of some food categories (snacks, beverages, cereals, crackers, pudding and combination dishes not measurable by a cup, such as pizza) were considered "less healthy" according to the UK's Nutrient Profiling system when they were marketed to children compared to when they were not marketed to children.[56] Elliott[55] and Murray[56] both found that 1% or less of foods marketed to children were vegetables or fruits.

Influence of regulation on exposure

Neither the QCPA nor the CAI explicitly applies to product packaging. No research exists on the impact of the QCPA on product packaging. The impact of the CAI on the overall exposure to product packaging targeted at children is not documented; however, Murray found that the CAI did not impact the nutritional quality of foods marketed to children through product packaging.[56]

Power of food marketing in supermarkets

The majority of grocery store products Elliott reviewed had "fun" features on product packaging, including cartoons and cartoonish fonts.[54] Murray found that unusual flavours, shapes and colours, characters and graphics or lettering were the most commonly used marketing techniques on products targeting children.[56] In an analysis of breakfast cereals boxes, 48% had child-oriented colours, 35% had incentives or premium offers and 34% had spokes-characters.[53]

Similar to research on television food advertisements, powerful marketing techniques on product packaging were associated with poor quality foods.[53,54] In particular, breakfast cereals were more likely to be higher in sugar if their packaging targeted children.[53] As well, over two-thirds of non-junk, high-sugar products had a nutrition claim, compared to only half of "healthier" products.[54] Berry and McMullen suggested that the marketing landscape in the cereal aisle in Canada is "health-exploitive,"[53,p.334] meaning that it uses child-directed marketing techniques on less healthy products, encouraging their consumption.

Influence of regulation on power

Not documented.

Impact of food marketing on children in Canada

The evidence of a causal impact of food marketing on children's food attitudes, preferences and behaviours is compelling and has been discussed elsewhere.[6,61,62] Although limited, Canadian studies provide local insight into how children in Canada are impacted by food marketing. Experimental and qualitative studies in Canada have shown that television product placement,[48] online advertising,[49] product packaging,[35,57,58,60] and toy premiums[59] can impact Canadian children's attitudes, preferences, and behaviours.

Hudson and Elliott[48] found that although only 17% of children (7-12 years) were aware of product placement, children who viewed a television program with unhealthy product placements (vs. no product placement or healthy product placement) were most likely to recall the advertised products. Almost one-quarter of children aged 7 to 13 years said they purchased or requested a food advertised online (most commonly soft drinks, chocolate and candy).[49]

Researchers used focus groups of children aged 5 to 12 years to assess children's preferences, perceptions and interpretations of packaged foods.[35,57,58] Preferences were commonly influenced by packaging that used themes of fun and was esthetically pleasing or interactive.[57] When asked to identify healthy products, children created their own, often inaccurate, rationales based on colours,[57] nutrition or organic claims,[35,57] ingredient lists[35,57] and sometimes nutrition facts tables.[35,57] Results from focus groups with 225 children across Canada revealed that marketing features (colours, words, pictures, spokes-characters and front-of-pack claims) were more regularly used than nutrition facts and ingredient lists in evaluating the healthfulness of packaged foods.[58]

Elliot et al.[60] investigated whether 6 to 11 year old children's taste preferences differed based on food packaging design. When compared to food in plain packaging, children preferred the food in McDonald's packaging; however, this preference was not maintained when food in McDonald's packaging was compared to colourful or Starbucks packaging. Exploring a method of healthy food promotion, Hobin et al.[59] assessed the impact of toy premiums on meal choice. Children (aged 6–12 years) who were offered toy premiums with healthy options only (vs. healthy and unhealthy options) were over three times as likely to select the healthy meal.[59]

Finally, evidence from qualitative studies that were not setting-specific show that Canadian children have homogeneous attitudes towards food,[36,40] suggesting that cumulative exposures to food marketing may have a greater impact on children's food culture than a single exposure in a study. Focus groups conducted in Alberta, Ontario and New Brunswick with children aged 6 to 11 years showed that children distinguished between food for themselves and for others.[40] They reported that "kids' food" is junk food, sugary, associated with cartoons, comes in fun shapes or colours and is something you can play

with or eat with your hands.[40,p.133] These symbolic features identified by children mimic the powerful techniques listed in this review and used by the food industry to market to children. Conversely, children saw adult food as plain, unprocessed, healthy, responsible food, and not for them.[40] As well, adolescents (aged 12-14 years) personify food in a consistent manner across Canada:[36] broccoli is "shy, unpopular, and boring,"[36,p.87] and milk is "athletic"[36,p.87] (except for older boys). They see junk food, on the other hand, as a "party person" who is "funny and fun to hang around with."[36,p.87] Children's food attitudes may have been socially constructed by commercial food marketing, or the lack thereof, and may partly explain why the children's diets do not align with Canada's Food Guide.

Discussion

This scoping review found evidence of multiple exposures to food marketing to children in different settings—at home, at school and in supermarkets. With the exception of television and product packaging, the evidence base is limited. Fast food restaurants represent another setting where food marketing would be expected, but only the impact of promotional techniques used in fast food restaurants[59,60] has been studied in Canada. International research has documented food marketing in other settings (restaurants,[63] sports centres[64] and outside[65]) and thus, this review likely underestimates Canadian children's exposure. Foods high in energy, fat, sugar and salt were commonly marketed in all settings, which is consistent with findings from other research.[6] Children were often targeted with powerful promotional techniques that were multiple and varied, and overlapped across settings; food marketers have an arsenal of marketing tools.

With the exception of limited positive influences of the statutory regulation in Quebec on television food advertising, current evidence suggests that statutory and self-regulations in Canada have not improved either children's exposure to or the power of food marketing; however more research is needed to understand regulations' impact across settings. Dhar and Baylis estimated that the QCPA has positively impacted population health by reducing weekly household fast food consumption in French-speaking, but not English-speaking, households with children in Quebec since English-speaking households may view non-Quebec food marketing not covered under the QCPA.[66] Although the influence of regulation in schools has not been measured, a 2004 survey of all Canadian public schools found that prevalence of commercial (food and non-food) advertising was lower in Quebec than the rest of Canada.[67] Quebec's statutory regulation, a rights-based approach to child health,[4] may better influence the settings and context in which children live, compared to industry self-regulation.

The evidence synthesis presented here shows that food attitudes, preferences and behaviours of Canadian children are impacted by exposures to food marketing in a single setting. More important, however, may be the uniformity of food attitudes among Canadian children, which is suggestive of a nonspecific, collective impact of food marketing exposure over time and across place. As children become increasingly immersed in marketing throughout their lives, and as promotional techniques and channels integrate and overlap more often,[68] it is reasonable to ask whether exposures to unhealthy food marketing have a greater cumulative impact[61] than when viewed separately by promotion type.

The body of evidence presented in this scoping review must be considered within the daily life of an average Canadian child, who watches two to three hours of television,[69] uses the computer or plays video games for one to two hours,[69] sits in school for five to six hours[70] and whose family shops for groceries almost every second day.[71] In that light, it becomes more obvious that children in Canada (with the exception of some in Quebec) are at risk of exposure to an astounding volume of powerful food marketing. Furthermore, the settings where food marketing occurs that the author has identified in this review are common places for children to eat, buy or learn about food.

The study of Vancouver schools may suggest that children's exposure to unhealthy food marketing is less frequent and the marketing is less powerful in schools than in other settings, since only one-quarter of foods advertised were unhealthy and powerful promotional techniques were rare.[52] This finding may be noteworthy, as it may signify that settings-based policies, such as British Columbia's mandatory school food policy with food marketing recommendations,[21,22] are more comprehensive and efficient than traditional promotion-focussed regulations. The latter may not reach the extensive food-related commercialization in Canadian public schools previously reported,[67] including exclusive agreements with Coca-Cola and Pepsi, incentive programs (Campbell's Labels for Education) and sponsored educational materials (Pizza Hut's "Book it", Mr. Christie's "Smart Cookie"). Unfortunately, the limited research precludes conclusions about the state of marketing in schools, especially since variability in school food policies likely contributes to different food marketing environments in schools across Canada.

Experts have recommended strong, comprehensive statutory regulations with independent monitoring and compliance penalties to effectively reduce children's exposure to powerful unhealthy food marketing.[72,73] Nevertheless, those planning interventions must consider how multiple exposures to food marketing interact and socially construct food attitudes and behaviours in children's everyday settings. The tendency for regulations to focus on the promotional aspects of food marketing[74] without considering the settings where children eat, buy or learn about food may increase the risk of policies that inadequately intercept marketers' plans to reach children. Settings as a component in the proposed Canadian food marketing regulations[17] is valuable if the regulations consider settings not as just promotional marketing channels, but as the places where behaviours are performed or related goods and services are acquired[8] – where children eat, buy and learn about food.

Implications for policy and research

A comprehensive approach to restricting unhealthy food marketing to children that addresses product, promotion, place and price may require action by policy makers, industry and communities.

In the United States, Palaskhappa et al. found that lower childhood obesity prevalence was associated with strong laws regulating the sale of unhealthy foods (OR = 0.68, 95% CI:0.48–0.96) and food advertising in schools (OR = 0.63, 95% CI:0.46–0.86), compared to states with no laws.[75] Furthermore, states with multiple strong school food laws (two or more) compared to states with no laws had reduced risk of obesity in elementary

schools and of overweight in middle schools.[75] The success of this kind of regulation demonstrates that government policy regulating the food industry, if it follows research-based recommendations,[73] can be paired with local settings-based initiatives to prohibit unhealthy food marketing in the places where children live, learn and play, such as schools and recreation facilities. The places where we eat, buy and learn about food are critical points of intervention for health promotion, just as they are critical targets for the food industry.

The goal of marketing restrictions should be to improve children's everyday lives, not just limit the marketing channels used to reach them. Solely focussing on the promotional aspects of food marketing may allow marketers continued access to children by simply switching from one marketing technique to another. The increase in new media marketing techniques and decrease in television marketing observed in the United States after the introduction of industry self-regulation[68] may be evidence of such a consequence. The sectors that disseminate food marketing (schools, media, retailers, sports organizations, etc.) are key actors in supporting food marketing restrictions.[9]

Using the broadcast industry's code as an example of sector-based action,[12] organizations and communities can take the lead in place-based interventions by developing their own marketing or sponsorship policies that address the promotion, place and pricing of unhealthy food and beverages. Setting-based health promotion helps to shift the focus from an individualistic risk-factor approach to one that appreciates the complexity of interconnecting environmental and individual factors influencing health.[14] Whole-system approaches, a feature of settings-based interventions, with actions by government, industry and communities may impact culture more widely than traditional reductionist approaches that view issues linearly with single causes and outcomes.[14] For example, school food polices, which may include multiple aspects of marketing (see Table 1), can be expanded to comprehensively address all 4Ps. In addition to proposed marketing regulations, policy makers may also consider adopting additional supporting interventions that target broader aspects of marketers' 4Ps, such as product availability through industry reformulation, or food pricing via taxes and subsidies, in a whole-system intervention to reduce the impact of food marketing. A 4Ps policy strategy may help address unhealthy food marketing in situations where it is not applicable or feasible to introduce a settings-based policy, such as in the business sector.

Further research is needed to fully examine children's exposure to and the power and impact of food marketing within the settings of children's everyday lives and consider the influence of all 4Ps. Specifically, more research is needed on how settings, such as schools, recreation centres, daycares, retailers and other spaces, can be targeted when creating policy to protect children from unhealthy food marketing. More research is also needed on children older than 12 years and population subgroups (e.g. by income or ethnicity) to completely understand the state of food marketing to children in Canada and its impact.

Strengths and limitations

The settings-based approach[18] used to conduct this review diverges from the usual siloed media/promotion perspective and provides fresh insight into children's exposure to food marketing, its power and its impact on their lives. By critiquing the literature through the 4Ps marketing lens, this review bridges the population health and business disciplines and provides a novel perspective on population health interventions and research on food marketing to children.

Restricted to peer-reviewed, English-language research in Canada, however, the findings in this review may underestimate children's exposure to and the power of food marketing in Canada. The limited search strategy may have excluded studies that cursorily measured food marketing to children as a part of broader study objectives irrelevant to this review. With only 23 studies (mostly cross-sectional) published over the last decade, the temporal aspects of marketing are not well documented. Due to the mix of study designs, the quality of studies was not evaluated.

Conclusion

Creating environments that support healthy diets for children is a priority in Canada as a strategy to reduce the prevalence of childhood obesity.[76] However, food marketing in the settings where children eat, buy and learn about food encourages "fun" junk foods inconsistent with healthy diets. The findings from this scoping review suggests that statutory and voluntary regulations are not adequately protecting Canadian children from exposure to powerful unhealthy food marketing. Complementary actions from government, industry and communities, such as strong, enforced and monitored statutory regulations and broadened school food policies, may be needed to address the multifaceted nature of powerful food marketing. With almost seven million children under 18 years[77] in Canada and 400 000 new births every year,[78] protecting the places where children live, learn and play from unhealthy food marketing constitutes one of the strategies needed to help reverse the tide of childhood obesity in Canada.

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Conflicts of interest

Rachel Prowse has no financial relationships that may pose a conflict of interest.

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Development, reliability and use of a food environment assessment tool in supermarkets of four neighbourhoods in Montréal, Canada

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Abstract

Introduction: The food environment is a promising arena in which to influence people's dietary habits. This study aimed to develop a comprehensive food environment assessment tool for businesses and characterize the food environment of a low-to-medium income area of Montréal, Canada.

Methods: We developed a tool, *Mesure de l'environnement alimentaire du consommateur dans les supermarchés* (MEAC-S), and tested it for reliability. We used the MEAC-S to assess the consumer food environment of 17 supermarkets in four neighbourhoods of Montréal. We measured the shelf length, variety, price, display counts and in-store positions of fruits and vegetables (FV) and ultra-processed food products (UPFPs). We also assessed fresh FV for quality. Store size was estimated using the total measured shelf length for all food categories. We conducted Spearman correlations between these indicators of the food environment.

Results: Reliability analyses revealed satisfactory results for most indicators. Characterization of the food environment revealed high variability in shelf length, variety and price of FV between supermarkets and suggested a disproportionate promotion of UPFPs. Display counts of UPFPs outside their normal display location ranged from 7 to 26, and they occupied 8 to 33 strategic in-store positions, whereas the number of display counts of fresh FV outside their normal display location exceeded 1 in only 2 of the 17 stores surveyed, and they occupied a maximum of 2 strategic in-store positions per supermarket. Price of UPFPs was inversely associated with their prominence ($p < .005$) and promotion ($p < .003$). Store size was associated with display counts and strategic in-store positioning of UPFPs ($p < .001$), but not FV, and was inversely associated with the price of soft drinks ($p < .003$).

Conclusion: This study illustrates the variability of the food environment between supermarkets and underscores the importance of measuring in-store characteristics to adequately picture the consumer food environment.

Keywords: nutrition, food environment, consumer food environment, fruits and vegetables, food processing, food marketing, obesity, ultra-processed food products

Highlights

- The MEAC-S tool was designed to assess and monitor the consumer food environment in Montréal, Canada, and has shown robust interrater reliability.
- The availability and price of fruits and vegetables vary greatly among supermarkets.
- Ultra-processed food products, unlike fruits and vegetables, are highly and disproportionately promoted inside supermarkets, their promotion increasing with store size.
- When assessing the community food environment, food stores cannot be dichotomized into healthy versus unhealthy, as this does not comprehensively capture the food environment to which consumers are exposed.

Introduction

More than half of Canadian adults are overweight (36.8%) or obese (25.1%).[1] This represents a significant social and financial burden for the country, with up to 12% of total health expenditures in Canada estimated to be attributable to obesity.[2] In Quebec alone, the annual cost of excess weight has been estimated at 3 billion dollars.[3] Meanwhile, eating behaviours, which are considered one of the main determinants of body weight and a modifiable risk factor for the development of many noncommunicable diseases,[4] are not optimal in Quebec. The mean consumption of fruits and vegetables (FV) in the adult population is under five portions per day.[5] A recent analysis of the data for Quebec in the Canadian Community Health Survey, Cycle 2.2, Nutrition (2004), have also reported that ultra-processed food products (UPFPs) represent almost half of calories consumed (47%) in the province.[6]

The food environment has been shown to influence food choices and dietary patterns.[7] Community (accessibility of different types of food stores) and consumer (what is available inside food stores) food environments have been associated with FV consumption,[8-13] diet quality,[8,11,14-18] and weight.[19-25] In Canada, the current food environment provides cheap, readily available, and massively marketed high-energy-density foods and UPFPs.[26] In such

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a skewed food environment, nutrition education is most likely insufficient to improve the population's eating habits.[27,28] To start curbing the rise in the prevalence of obesity, changes in the food environment are essential to make the healthy choice the easy choice.

The food environment in Canada and in Quebec is currently not well documented. This scarcity of data impedes the ability to orient, develop and implement interventions and policies that would make it conducive to healthy eating.[29] A recent review by Minaker and colleagues[30] particularly highlights the lack of research on the consumer food environment in Canada, with only one paper that used measures of the consumer food environment to study the association between food environment and health outcomes. While store proximity and availability in one's neighbourhood have been linked with diet quality, studies have reported inconsistent results,[31] suggesting that physical accessibility alone might not be sufficient to explain dietary habits. The availability and affordability of the foods within those stores may be contributing to the association between food store access and food store choice, eating behaviours and health outcomes.[32,33]

More than 30 different food environment assessment tools have been identified.[34] The two most frequently used tools are the Nutrition Environment Measures Survey in Stores (NEMS-S)[35] and the USDA Thrifty Food Plan.[36] These tools describe the availability and price of a variety of food products. The NEMS-S also assesses produce quality. Neither of them, nor most other food environment assessment tools,[34] describe food promotion or the prominence of food categories inside food stores, despite the influence of these factors on food-purchasing decisions.[37-40]

The objectives of this study were to (1) develop a food store survey that incorporates the components of the consumer food environment as defined in the Model of Community Nutrition Environments developed by Glanz and colleagues, including promotion and placement[7]; and (2) characterize the consumer food environment of a low-to-medium income area (4 neighbourhoods) in the southeastern part of Montréal.

Methods

Tool development

The *Mesure de l'environnement alimentaire du consommateur dans les supermarchés* (MEAC-S) was developed to assess the consumer food environment inside supermarkets.

Food categories

The MEAC-S includes two foods categories: those that have been documented to be consumed in insufficient quantities (FV category) and those that have been documented to be consumed in too large quantities (UPFPs category) according to recommendations in Canada's Food Guide.[5,6] The FV category includes fresh, frozen, canned and ready-to-eat FV. The UPFPs category, defined as food products formulated from industrial ingredients and containing little or no whole foods,[41] includes chips, soft drinks, frozen entrees and confectioneries. These foods were chosen because they accounted for 11% of total supermarket sales in the province in 2013 to 2014.[42]

Pilot testing revealed that confectioneries were available in multiple locations within the store and often shared shelves with other food products. This placement of confectioneries precluded reliable assessment of variety and shelf length for these products. Confectioneries were thus only assessed for availability in strategic in-store positioning.

Key indicators

The MEAC-S assessed availability, affordability, prominence and promotion for both food categories inside supermarkets. Indicators included in the tool are listed and defined below.

1. Availability of food items was operationalized using three indicators: the variety of items in each food category, the shelf length they occupy in the supermarket and the quality of produce.

Variety was calculated by counting every available item per food category, including different sales formats, brands, flavours and types. For example, all available varieties of the same kind of fruit or vegetable were counted separately.

Shelf length was calculated using a step-length method.[43] The auditor walked in front of every shelf of food included in the tool while counting her steps, which were previously calibrated. In order to measure the accessibility of food for shoppers, audits were taken from every aisle, around island displays and near the cash registers. When a food category was available in multiple locations inside a store, the measurements for all locations were summed to obtain the total shelf length for that food category. Shelves' depth and height were not measured nor accounted for. The total shelf length measured for all food groups was summed to create a proxy of store size.

Quality of produce was evaluated on a three-point scale, from −1 to 1. It was audited separately for fruits and vegetables and was based on the auditor's evaluation of freshness, according to their appearance, smell and ripeness level. Full criteria for freshness evaluation are provided in the MEAC-S user guide (available from the authors upon request, in French only).

2. Affordability of food was evaluated through the price per portion for FV, price per 100 g for chips and frozen entrees and price per 2 L for soft drinks. Promotion prices were not considered.

The price per portion for fruits and vegetables was calculated using, respectively, the mean price for one portion of apple, banana, strawberry and orange, and the mean price for one portion of tomato, carrot, lettuce and cucumber. Canada's Food Guide served as a reference for portion size. When more than one kind of these fruit or vegetable was available (e.g. 17 kinds of apple), the lowest regular price was selected.

The prices per 100 g of chips and frozen entrees and per 2 L of soft drinks were audited for the lowest-priced product in each store, usually the private label brand. The auditors also recorded prices of standard products that were shown to be available in every store during pilot testing. The standard product for chips was the 180 g bag of Lay's Original chips and the standard product for frozen entrees was the 286 g Stouffer's lasagna. The 2 L bottle of Coke was the standard product for soft drinks.

3. Indicators of prominence were developed to describe the simultaneous exposure

to healthy and unhealthy food products. These include the "ratio of variety" and the "ratio of shelf length" of FV to UPFPs. The ratio of variety was calculated by dividing the number of products available in the FV category by the number of UPFPs available. The ratio of shelf length was obtained by dividing the total FV shelf length by the total UPFPs shelf length.

4. Promotion of food items was operationalized using two indicators: display counts and strategic in-store positioning of FV, chips, soft drinks and confectioneries. Display counts represent the number of times food products were found outside their principal point of sale in the store (e.g. chips are available in many other locations inside a store other than the chip aisle). Strategic in-store positions are the end of aisles, areas near the cash registers and ready-to-eat displays. The auditors noted the number of these positions occupied by FV, chips, soft drinks and confectioneries.

We conducted a pilot study in five food stores, and adjusted the MEAC-S to facilitate data collection. The final form is presented in Figure 1. The complete user guide is available (in French only) upon request to the corresponding author.

Data collection

The study took place in four low-to-medium income neighbourhoods in the southeastern part of Montréal, Canada. These neighbourhoods are divided into eight Forward Sortation Areas (FSAs). The first three characters of the postal code identify the FSA. We evaluated every supermarket in these FSAs.

We selected supermarkets using a Google map search. The FSA was entered as primary term and the terms "supermarket" or "grocery store" were entered in the local search engine. We found a total of 57 food stores, of which 18 were supermarkets. In order to ensure that every supermarket was visited, we systematically tracked food stores by going through every major street in the four neighbourhoods. Two stores were not eligible for auditing as one was closed permanently and another was a convenience store. One supermarket was also added to the list, for a total of 17 supermarkets, as illustrated in Figure 2.

Data were collected between May and July 2015 to avoid seasonal influences on FV availability, price and prominence.

We did not seek permission from store managers to assess the food environment inside their supermarket. Therefore, subtlety was a key component of the data collection. The MEAC-S form was printed and folded like a grocery shopping list and the auditor bought food items in every store visited to avoid unwanted attention. No intervention from store managers or employees compromised data collection.

Interrater and test-retest reliability

In November 2015, five months after the first assessment, two auditors reassessed six stores to evaluate the MEAC-S for interrater and test-retest reliability.

Statistical analysis

We calculated intraclass correlation coefficients (ICCs) with a two-way random ANOVA model assessing for absolute agreement to evaluate the MEAC-S for interrater and test-retest reliability.

We conducted Spearman correlations between price and prominence indicators, and between store size and all other food environment indicators in supermarkets.

All statistical analyses were performed in SPSS Statistics version 19.0 (IBM Corp., Armonk, NY, USA). A p-value inferior to .05 was considered significant.

Results

All supermarkets included in the study are chain supermarkets, with estimated annual chain sales exceeding $150 million.[44]

Audits lasted on average 56 minutes (32–75 minutes). We assessed interrater and test-retest reliability using the ICC coefficient for each indicator. An ICC coefficient above 0.75 indicates excellent agreement and an ICC coefficient between 0.40 and 0.75 indicates medium-to-good agreement.[45]

All indicators had an ICC coefficient above 0.85 for interrater reliability, suggesting excellent agreement between auditors. The ICC coefficients for test-retest reliability were lower. ICC coefficients below 0.75 were found for indicators of display counts (0.43) and strategic in-store positioning (0.53) and coefficients were mostly invalid for indicators of price due to within-group to between-group variance (Table 1).

Consumer food environment

Overall availability, affordability, prominence and promotion of food items per supermarket are described in Table 2.

Availability of food items differed greatly among supermarkets, as illustrated by the variability in variety and shelf length indicators. We calculated variety and shelf length ratios for each store. Ratios above 1.0 indicate greater presence of FV, whereas ratios under 1.0 indicate a greater presence of UPFPs. Two supermarkets had variety ratios inferior to 1.0 and five supermarkets had shelf length ratios inferior to 1.0.

Price per portion of vegetable varied more than twofold and price per portion of fruit more than threefold from one supermarket to another.

Quality of FV did not differ significantly among supermarkets; most of them offered FV of the highest quality.

Display counts and strategic in-store positioning for UPFPs greatly outnumbered those for FV. Nine supermarkets did not have display counts for FV outside their normal display location or strategic in-store positioning for FV, and of the stores that did, 6 out of 8 were for canned FV. In comparison, all stores had at least 7 additional display counts and 8 strategic positions occupied by UPFPs.

Price and prominence of ultra processed food products

Results showed that the price of UPFPs such as chips and soft drinks was inversely associated with their availability, prominence and promotion in the supermarket (Table 3). This association was not seen for FV (data not shown).

Consumer food environment indicators and supermarket size

Because supermarket size could account for some of the results, we conducted Spearman correlations between the store size proxy and indicators of the consumer food environment, excluding shelf length measurements (Table 4).

FIGURE 1
MEAC-S measurement form

Store: _____ Address: _____

Evaluation date: _____ Duration: _____

Promotion			UPFPs			FV	Promotional material	
In-store positions	Number	Occupied by UPFPs	Sodas	Chips	Confectioneries			
End of aisles							UPFPs	
Cash registers								
Ready-to-eat area							FV	

Food items		Availability		Price (w/ promotion)		Quality		
		Variety	Shelf length (steps)	Per unit	Per kg	−1	0	1
Fruits and vegetables								
Fresh fruits								
Fresh vegetables								
	Apple							
	Banana							
	Strawberry							
	Orange							
	Tomato							
	Carrot							
	Lettuce							
	Cucumber							
Potato								
Ready-to-eat FV								
Frozen	**Fruits**							
	Vegetables							
Cans	**Fruits**							
	Vegetables							
	Tomatoes							
Ready-to-eat								
Prepared by store								
Frozen entrees				**Format (g)**	**Price/unit**			
	Cheapest brand:							
	Standard product:	Stouffer's individual lasagna		286 g				
Ultra-processed food products								
Chips				**Format (g)**	**Price/unit**	**Display counts (excluding principal point-of-sale)**		
	Cheapest brand:							
	Standard product:	Lays Original, regular size		180 g				
Soft drinks				**Price/2L**				
	Cheapest brand:							
	Standard product:	Coke, 2L						

Abbreviations: FV, fruits and vegetables; MEAC-S, *Mesure de l'environnement alimentaire du consommateur dans les supermarchés*; UPFP, ultra-processed food product; w/, without.

FIGURE 2
Study area in Montréal, Canada

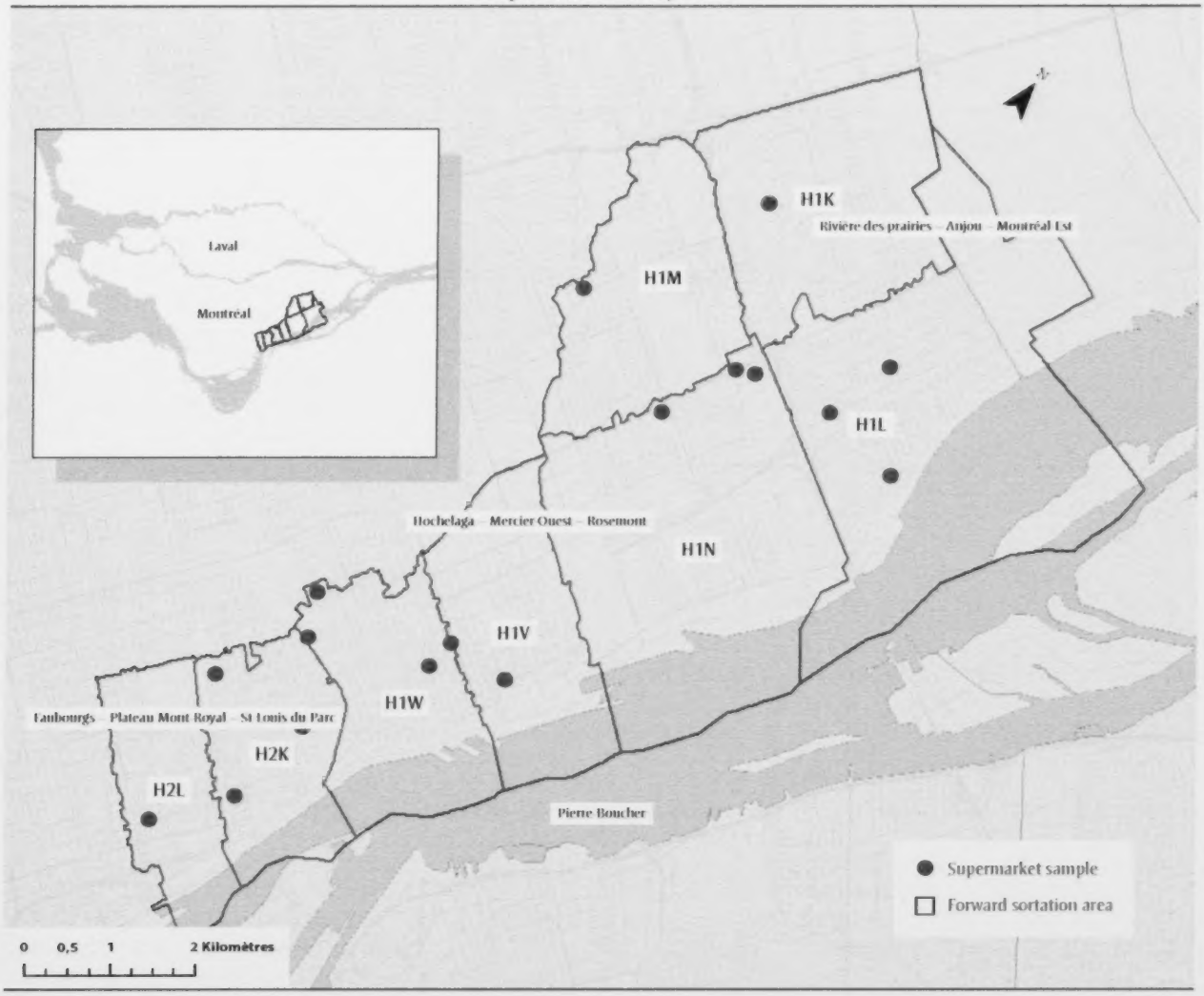

TABLE 1
Interrater and test-retest reliability for consumer food environment indicators included in the MEAC-S

Indicators	ICC	
	Interrater	Test-retest
Variety	0.888	0.876
Shelf length	0.908	0.894
Display counts	0.951	0.431
Quality	0.968	0.968
Price	0.883	NV
Strategic in-store positioning	0.845	0.529
Mean ICC for all indicators	**0.894**	**0.607**

Abbreviations: ICC, Intra-class correlation coefficient; MEAC S, *Mesure de l'environnement alimentaire du consommateur dans les supermarchés*; NV, not valid.

Store size was positively associated with UPFPs variety, display counts and strategic in-store positioning and inversely associated with the price of soft drinks. It was also positively correlated to FV variety and display counts, though it should be noted that additional display counts for FV were present in only 8 supermarkets out of 17, and that most of these display counts were for canned, not fresh FV.

Discussion

This study's first objective was to develop a tool to assess the consumer nutrition environment inside supermarkets in the province of Quebec. The MEAC-S is used to audit foods that are under- or overconsumed

TABLE 2
Descriptive analysis of the consumer food environment inside supermarkets in four neighborhoods of Montréal, Canada, 2015

Consumer food environment indicators		Supermarkets (N = 17)	
		Mean	(min–max)
Variety	Fresh FV	221.3	(149–319)
	Total FV	518.6	(361–757)
	Ready-to-eat meals	79.3	(0–187)
	Frozen entrees	134.5	(41–209)
	Chips	235.7	(123–338)
	Soft drinks	41.7	(27–50)
	Ratio (FV/UPFPs)	**1.28**	**(0.89–1.48)**
Shelf length (m)	Fresh FV	89.1	(18.2–166.4)
	Total FV	123.0	(34.8–223.4)
	Ready-to-eat meals	11.2	(0.0–29.7)
	Frozen entrees	46.4	(18.6–91.5)
	Chips	39.6	(14.2–82.0)
	Soft drinks	26.8	(9.5–70.9)
	Ratio (FV/UPFPs)	**1.2**	**(0.64–2.34)**
	Total measured shelf length	247.0	(88.4–455.3)
Quality (−1,0,1)	F	0.8	(−0.5 to 1.0)
	V	0.9	(0.0–1.0)
Price ($)	F (per portion)	0.70	(0.43–1.22)
	V (per portion)	0.33	(0.22–0.53)
	Frozen entrees, HB (per 100 g)	0.72	(0.47–0.93)
	Stouffer's lasagna (per 100 g)	1.41	(1.39–1.57)
	Chips, HB (per 100 g)	0.99	(0.74–1.25)
	Lay's (per 100 g)	1.63	(1.23–1.99)
	Soft drinks, HB (per 2 L)	1.32	(1.00–1.99)
	Coke (per 2 L)	2.38	(1.67–2.79)
Display counts	FV	0.7	(0–3)
	Chips	9.9	(4–18)
	Soft drinks	5.5	(2–10)
Strategic in-store positioning	FV	0.5	(0–2)
	Chips	6.9	(3–13)
	Soft drinks	5.7	(2–9)
	Confectioneries	10.7	(3–17)

Abbreviations: F, fruits; FV, fruits and vegetables; HB, house brand; UPFP, ultra-processed food product; V, vegetables.

Notes: "Strategic in-store positions" are the ends of aisles, areas near cash registers, and ready-to-eat displays.
"Total measured shelf length" is a proxy measure for store size.

in Quebec, using eight indicators that reflect the consumer food environment in stores.

Overall data suggest variability among supermarkets, particularly regarding shelf length measurements and price of FV. The price of FV varied more than twofold between supermarkets. This can result in a difference of over $30.00 per week for a family of four, depending on their choice of supermarket, a considerable amount for low-income families living in the surveyed neighbourhoods.

Many studies have suggested that neighbourhood socioeconomic status (SES) is associated with FV and snack foods availability inside food retailers,[46,47] thus mediating the relationship between individual SES and diet quality.[33] However, the available data on SES in our study area do not match our geographic breakdown, thus restricting our ability to analyze the consumer food environment in the different FSAs with respect to their SES. Future studies should consider using geographic boundaries allowing for adequate integration of SES information.

Our results also showed that in this sample, almost 30% of the 17 supermarkets had a shelf length ratio below 1.0, indicating prominence of UPFPs in these stores. The limited number of UPFPs included in the MEAC-S likely underestimates this percentage.

Moreover, our data suggest that larger stores have more display counts and in-store positioning of UPFPs than do smaller ones, a relationship that is not observed for FV. This result is consistent with previous research showing that unhealthy food item promotion seems to be related to store size, whereas FV are found less frequently and in less prominent spaces, regardless of store size.[40] A study conducted in Montréal by Blanchard also suggested that shelf space of snack foods is more extensible than shelf space of FV.[46]

Most studies on community food environment categorize supermarkets as healthy stores.[48] While it has been shown that they usually do have a greater availability of healthy foods at lower prices when compared to other types of stores,[33,49] they also offer more UPFPs at lower prices[19,50] and their in-store content may vary greatly among supermarkets.[20,29] This study confirms these results and suggests that supermarkets cannot be uniformly considered healthy stores. Many researchers are urging their colleagues to explore the consumer nutrition environment further and revise their categorization of stores as healthy or unhealthy.[23,29,32,51]

In contrast to availability and price, produce quality did not vary among stores. This is probably due to the highest quality standard to which chain supermarkets adhere. In this context, the assessment of produce quality might be more valuable when comparing the food environment

TABLE 3
Spearman correlations between prominence and promotion indicators and price of ultra-processed food products

Price	Display counts: chips	Display counts: soft drinks	Display counts: UPFPs	Strategic in-store positioning: chips	Strategic in-store positioning: soft drinks	Strategic in-store positioning: UPFPs	Shelf length: chips	Shelf length: soft drinks	Shelf length: ratio	Variety: soft drinks
Chips (HB)	−0.690	NS	−0.674	−0.641	NS	NS	−0.521	−0.489	0.661	NS
	p=0.002		p=0.003	p=0.006			p=0.032	p=0.046	p=0.004	
Soft drinks (Coke)	−0.808	−0.653	−0.865	−0.842	−0.533	−0.834	−0.804	−0.767	0.695	−0.667
	p<0.001	p=0.004	p<0.001	p<0.001	p=0.028	p<0.001	p<0.001	p<0.001	p=0.002	p=0.003

Abbreviations: HB, house brand; NS, nonsignificant; UPFPs, ultra-processed food products.

Note: "Shelf length: ratio" is the ratio of FV shelf length to UPFPs shelf length.

inside different types of stores. It is also worth mentioning that in most supermarkets we visited, the produce section was located at the store entrance. These choices are likely not arbitrary and may reflect the marketing practices of store owners. A US study reports that consumers who choose to purchase food perceived as healthy, such as fresh FV, are more likely to choose to purchase high-energy-density and ultra-processed products later in their store visit.[52]

This study also found an inverse relationship between the price, promotion and prominence of UPFPs, but not of FV. Price, promotion and prominence are known to have a central influence on food purchasing behaviour. Marketing research suggests that increasing the shelf space, lowering the price and displaying products at the end of aisles or near cash registers all lead to increasing sales of these products.[14,37-40]

Notably, UPFPs were promoted in this way in all stores included in the study, which was not the case for FV. Strategic in-store positioning of unhealthy items not only increases the purchase of these items in percentage of total sales, but also reduces the purchase of FV.[40] Considering the influence of promotion and prominence on sales, a promising strategy to improve the consumer nutrition environment without compromising store profitability could be to encourage store managers, through financial incentives or regulations, to also apply this marketing mix to FV.[37,39]

Strengths and limitations

This study has many strengths and limitations. The MEAC-S was validated for inter-rater reliability with satisfactory ICC coefficients for all indicators, suggesting excellent agreement between raters. The ICC coefficients for test-retest reliability were somewhat less satisfactory. The production of FV being closely linked to climate and temperature, seasonal changes influence the in-store availability and price of produce, which could explain the lower ICC scores. Moreover, display counts and in-store positioning of food products may not be constant over time. This might be linked with in-store positioning of food products related to seasonal particularities or holidays. To limit the influence of seasonality on ICC scores, test-retest reliability of the MEAC-S should be evaluated again using a shorter timeframe. Precautions should also be taken when using the MEAC-S to assess the food environment quality over time or when comparing stores or neighbourhoods. To maximize comparability, the assessment should be done within the same season.

Another strength of this study is the indicators and measurements used. The MEAC-S tool includes every variety of each of the food categories surveyed. While including a larger variety can be time-consuming, it could allow for a more sensitive classification of food stores with regards to FV and food products availability. (For example, a study conducted in Montréal failed to detect differences between stores by SES area while using the NEMS-S checklist for fresh FV, but detected a significant difference when using a homemade checklist of 137 fresh FV.[46])

Additionally, the MEAC-S integrates measures of food prominence and promotion, such as additional display counts and strategic in-store positioning, which were found to be closely related to purchase behaviours.[37,39] To our knowledge, this is the first study to integrate both of these measurements in a food store survey. The MEAC-S also combines both absolute and relative indicators, which better illustrates the simultaneous exposure of consumers

TABLE 4
Spearman correlations between store size and indicators of the consumer food environment inside supermarkets of four neighborhoods of Montréal, Canada

	Variety			Display Counts			Price	Strategic in-store positioning		
	FV	Chips	UPFPs	FV	Chips	UPFPs	Soft drinks (Coke)	Chips	Confectioneries	UPFPs
Store size	0.527	0.784	0.655	0.577	0.821	0.772	-0.695	0.735	0.583	0.760
	p= .030	p< .001	p= .004	p= .015	p< .001	p< .001	p= .002	p= .001	p= .014	p< .001

Abbreviations: FV, fruits and vegetables; UPFPs, ultra-processed food products.

to both healthy and unhealthy food items.[29,48,49]

Finally, unlike the method proposed by other audit tools, MEAC-S indicators were not aggregated into a global quality score per supermarket. Results from different indicators did not converge and were sometimes in opposition regarding the quality of the food environment inside supermarkets (e.g. price per portion of vegetable positively correlated with FV prominence). Aggregation of these contrasting results would not give a complete and accurate picture of the situation and would possibly underestimate the importance of one or many indicators in relation with consumer's purchase behaviours or health outcomes. Moreover, all indicators of the consumer food environment may not be linked with dietary outcomes or weight in the same way and in every population subgroup.[51] The MEAC-S, by generating data for multiple indicators, allows for analysis between each component of the consumer food environment and dietary or health outcomes.

The main limitation of the MEAC-S is the inclusion of only a limited number of food products for assessment. This limitation was intended to ensure the tool was convenient and easy to use, particularly for public health practitioners that lack both time and human resources mostly due to budget constraints. The exclusion of UPFPs other than chips, soft drinks, frozen entrees and confectioneries likely underestimates the prominence of this category of products in our food environment. Furthermore, the MEAC-S does not provide information regarding healthy options within these food groups or for other available food categories, such as grains and proteins.

Another important limitation of this study is the exclusion of food stores other than supermarkets. There was a wide variety of other types of food stores in the study area, such as small grocery stores and produce stands. In Quebec, these types of stores accounted for 12.2% of food purchases in 2013, while 55.2% of food were purchased in supermarkets.[53] Therefore, excluding other types of stores may misrepresent the consumer food environment of neighbourhoods residents.[29] However, most consumers tend to choose supermarkets as their primary food store and visit other types of stores for smaller, complementary purchases between their main food shopping trips.[17,33] The inclusion of every supermarket within the four neighbourhoods thus probably depicts at least part of the food environment to which most of the residents are exposed.

In order to more accurately reflect financial accessibility to food items, promotion prices were excluded from the observations, despite their known influence on purchase behaviours.[54] In addition to display counts and strategic in-store positioning, further studies could also assess the frequency of price promotions per food category. Other limitations include the small sample of supermarkets and the urban, low-to-medium income setting in which the study was conducted, limiting the ability to generalize results to rural or higher-income areas.

Conclusion

To our knowledge, the MEAC-S is the first tool developed to assess the consumer food environment using such a broad set of measures, integrating availability and price, but also prominence and promotion indicators. Results illustrate the prominence and promotion of UPFPs over FV in the neighbourhoods surveyed and underscores the necessity to adequately picture the consumer food environment to which consumers are exposed, breaking with the dichotomous classification of stores as healthy or unhealthy. The MEAC-S could be used to reliably characterize and monitor the consumer food environment inside supermarkets, providing much-needed data to inform interventions and policies targeting the food environment to ultimately improve eating habits at the population level.

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Support for healthy eating at schools according to the comprehensive school health framework: evaluation during the early years of the Ontario School Food and Beverage Policy implementation

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Abstract

Introduction: Provincial, national and international public health agencies recognize the importance of school nutrition policies that help create healthful environments aligned with healthy eating recommendations for youth. School-wide support for healthy living within the pillars of the comprehensive school health (CSH) framework (social and physical environments; teaching and learning; healthy school policy; and partnerships and services) has been positively associated with fostering improvements to student health behaviours. This study used the CSH framework to classify, compare and describe school support for healthy eating during the implementation of the Ontario School Food and Beverage Policy (P/PM 150).

Methods: We collected data from consenting elementary and secondary schools in a populous region of Ontario in Time I (2012/13) and Time II (2014). Representatives from the schools completed the Healthy School Planner survey and a food environmental scan (FES), which underwent scoring and content analyses. Each school's support for healthy eating was classified as either "initiation," "action" or "maintenance" along the Healthy School Continuum in both time periods, and as "high/increased," "moderate" or "low/decreased" within individual CSH pillars from Time I to Time II.

Results: Twenty-five school representatives (8 elementary, 17 secondary) participated. Most schools remained in the "action" category (n = 20) across both time periods, with varying levels of support in the CSH pillars. The physical environment was best supported (100% high/increased support) and the social environment was the least (68% low/decreased support). Only two schools achieved the highest rating (maintenance) in Time II. Supports aligned with P/PM 150 were reportedly influenced by administration buy-in, stakeholder support and relevancy to local context.

Conclusion: Further assistance is required to sustain comprehensive support for healthy eating in Ontario school food environments.

Highlights

- Results from the Healthy School Planner classified most schools as "action" along the Healthy School Continuum. This suggests the presence of modest support for healthy eating, with room for improvement.
- The physical and social environments pillar was divided to examine the unique attributes within each environment type. The physical environment was well supported, with safe, clean spaces for students to eat. In the social environment pillar, healthy eating was not often highly valued, with few schools identifying healthy eating to be a "very high" (16%) or "high" (8%) priority.
- Programs and practices within the teaching and learning, partnerships and services and healthy school policy pillars required further buy-in from school administrators, additional funding and deeper engagement with school stakeholders.

Keywords: schools, nutrition policy, school health, food environment, comprehensive school health

Introduction

The school environment can facilitate the development of positive, healthy living behaviours in children during their formative years.[1,2] As the high prevalence of childhood obesity continues, schools have been encouraged to adopt policies that formally promote healthy eating behaviours among students.[4-6] Internationally, school nutrition policies have played a critical role in supporting the healthy eating behaviours of children.[7-9] In 2011, following the implementation of school nutrition policies in several Canadian provinces and territories, the province of Ontario mandated the School Food and Beverage Policy (Policy/Program Memorandum No. 150 [P/PM 150]) as a set of nutritional standards applied to foods and beverages offered for sale in school food venues, at school events and through nutrition programs.[10]

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The policy states that any school food venue must adhere to an 80%–20% rule. That is, of foods and beverages offered for sale, 80% or more must fall into the category "sell most," 20% or less into the category "sell less" and 0% into the category "not permitted for sale."[10] These P/PM 150 food categories are determined by fat, sugar, sodium, caffeine and/or calcium levels within specified categories of foods and beverages.[10] Schools are responsible for the implementation and ongoing monitoring of the 80%–20% rule, with up to 10 exemption days in each school year when even "not permitted" foods may be offered for sale.[10] Preliminary studies indicate that some school stakeholders have encountered difficulties implementing P/PM 150, thereby limiting the ability of schools to reach full policy compliance.[11-13] These findings are consistent with reports that nutrition policy adherence typically takes years.[14,15]

Policies can falter when the local context is unsupportive of the change (e.g. the policy does not meet the current needs of the target population, or individuals responsible for implementation are unsupportive or unwilling to change).[7,9] Moreover, there is evidence that health policy implementation is most effective when it is combined with other approaches to facilitate healthy behaviours in children.[16,17] The comprehensive school health (CSH) framework, for example, was informed by a social ecological approach, recognizing that in supporting positive student health behaviours, attention to school environments, teaching and learning and partnerships and services complements policy.[7,9,18-23] Such multidimensional approaches to school health, also called "health-promoting schools" and "coordinated school health" approaches, are intended to support the health and academic achievement of students.[24] The CSH framework is a model that examines the school environment using four interrelated pillars, defined in Table 1. Note that social and physical environments are combined in the model but are often observed and measured separately.

As P/PM 150 was mandated without a corresponding comprehensive implementation strategy, it is unknown how, or in fact whether, the school social and physical environments, teaching and learning, healthy school policy and partnerships and services pillars are working together in Ontario to support healthy eating.

TABLE 1
Comprehensive School Health pillars[24,25]

Pillars	Definition
Social and physical environments	The social environment includes: • the quality of the relationships among and between staff and students in the school • the emotional well-being of students • relationships with families and the wider community • support of the school community in making healthy choices by building competence, autonomy and connectedness
	The physical environment includes: • the buildings, grounds, play space, and equipment in and surrounding the school • basic amenities such as sanitation, air cleanliness and healthy foods • spaces designed to promote student safety and connectedness and minimize injury • safe, accessible environments that support healthy choices for all members of the school community
Teaching and learning	Teaching includes: • formal and informal provincial/territorial curriculum, resources and associated activities
	Learning includes: • knowledge, understanding and skills for students to improve their health and well-being and thereby enhance their learning outcomes • professional development opportunities for staff related to health and well-being
Healthy school policy	Policies, guidelines and practices that promote and support student well-being and achievement and shape a respectful, welcoming and caring school environment for all members of the school community
Partnerships and services	Partnerships include: • the connections between the school and students' families • supportive working relationships within schools (staff and students), between schools, and between schools and other community organizations and representative groups • health, education and other sectors working together to advance school health
	Services include: • community and school-based services that support and promote student and staff health and well-being

Source: Adapted from Pan-Canadian Joint Consortium for School Health. The 4 Components of Comprehensive School Health [Internet]. Summerside (PE): The Joint Consortium for School Health; 2017 [cited 2014 Sep]. Available from: http://www.jcsh-cces.ca/index.php/about/comprehensive-school-health/4-pillars-explained

Therefore, using the CSH framework as a guide, our research aimed to (1) classify and compare the level of support for healthy eating within the CSH framework overall and for each CSH pillar across two time periods during the early years of P/PM 150 implementation; and (2) identify and describe the aspects of the school environment for which high levels of support were recorded and/or for which improvements were made within CSH pillars between the time periods we studied. This research provided an opportunity to examine policy implementation in the context of broader supports for healthy eating over time in the naturalistic setting of schools in a large, diverse region of Ontario.

Methods

Setting

This research was conducted in a populous region of Ontario, Canada, in partnership

with the local regional public health unit. The identity of the region and regional school boards is blinded in this article to protect the anonymity of participating schools. Data were collected from the two school boards (public and Catholic) at two times: Time I (April 2012 to June 2013) and Time II (December 2013 to June 2014). These time periods captured the early years of P/PM 150 implementation and were influenced by the political environment and restrictions placed on the timing for the recruitment of school staff in accordance with regional school board ethics review agreements. All aspects of this research received approval from the University of Waterloo Office of Research Ethics and the scientific review committees of participating school boards.

Participants

We recruited elementary and secondary schools for this study. We selected a random sample of 38 schools from all elementary schools (N = 318) within participating school boards. Randomization was based upon geographic distribution across the three municipalities, school neighbourhood socioeconomic status, school population size, and equal representation between public and Catholic school boards. While rural schools were included, the study area is a predominantly urban region. All secondary schools in Ontario have on-site food venues offering daily service, while elementary schools offer limited (e.g. vending machines) or occasional (e.g. monthly specialty hot lunches) services. Therefore, secondary schools were considered more likely to be impacted by P/PM 150 standards, and all regional secondary schools (N = 62) were invited to participate.

The principal from each participating elementary and secondary school was recruited through letters drafted by the authors and distributed by the regional school public health nurses (PHNs). A school representative was identified (either self-identified or selected by school administration) as being knowledgeable of healthy eating–related initiatives at their school. As this research took place over different school years, the representative changed in five cases from Time I to Time II.

Instruments

Consenting school representatives were asked to complete a paper and pencil version of the Healthy School Planner (HSP) survey and assist a university researcher with the on-site completion of a school food environmental scan (FES) checklist.

Healthy School Planner (HSP) survey

The HSP survey was developed by the Pan-Canadian Joint Consortium for School Health, and is a tool that can be used to classify a school's level of support for healthy eating, physical activity, tobacco control and/or positive mental health along the Healthy School Continuum (HSC) (Table 2) by asking 9 to 12 closed-ended indicator questions for each CSH pillar.[25] The HSC rates schools within the "initiation," "action," or "maintenance" phase dependent on the level of support within the selected health topic.[26] We selected the HSP survey's healthy eating module for this study as it directly corresponds to the pillars of the CSH framework. Questions in this module capture the presence and frequency of healthy eating–related programs (e.g. "Does your school offer cooking classes, gardening, trips to local farmer's markets?") and practices (e.g. "Does your school avoid the use of junk food as a reward through formal policies, informal practices, or not?"). Although no validation studies are available, the HSP has been acknowledged by the Health Council of Canada and Accreditation Canada as being sufficiently reliable and valid following revisions in 2009.[27] Since the inception of our research study, the HSP survey has undergone reformatting and its scoring procedures have been revised. To strengthen consistency and comparability of findings, we opted to use the paper-based HSP survey, with corresponding HSC, in both time periods.[26] More information on the HSP is available at http://hsp.uwaterloo.ca.

Food environmental scan (FES) checklist

We developed the FES as an addendum to the HSP, which included 27 open- and closed-ended questions regarding the status of P/PM 150 implementation and healthy eating–related programs, practices and policies within each school. Prior to our study, the checklist had been pilot tested in secondary schools in a different region.[28] The checklist included questions such as, "How many P/PM 150 exemption days has your school used and for what?"; and, "Are there opportunities for students to participate in gardening? If so, explain. If not, what barriers prevent such opportunities and what is needed to overcome these barriers?" We revised the FES checklist in Time II to include prompts to facilitate discussions led by the Time II data collector and additional questions to document changes to the school food environment since Time I (e.g. "Do you have the same cafeteria vendor as last year? If not, how does this vendor differ from last year's vendor?"). (A copy of the FES checklist is available from the corresponding author upon request.)

Scoring and analysis

HSP survey scoring

We scored each school's HSP using a three-step procedure, with outcomes compared across the two time periods.[26]

Step 1: Scoring of CSH pillar indicator questions

Responses to indicator questions were given a score of 1.0 (classified as "initiation"), 2.0 (classified as "action"), or 3.0 (classified as "maintenance").

Step 2: Calculation of separate CSH pillar ratings

We calculated the mean scores for pillar indicator questions. We gave each pillar a rating of initiation, action or maintenance based on the means (i.e. 1.0–1.99 = initiation; 2.00–2.80 = action; and 2.81–3.00 = maintenance).

Step 3: Calculation of an overall CSH rating

We calculated the means across the five CSH pillar scores and assigned an overall

TABLE 2
The Healthy School Continuum[25]

	Initiation	Action	Maintenance
Extent of meeting recommendations	Falls short of meeting recommendations	Meets some, but not all recommendations	Meets or exceeds recommendations
Recommendations for the future	Extensive room for improvement	Some room for improvement	Maintain current level of commitment to support healthy eating at school

CSH rating along the HSC (i.e. 1.0–1.99 = initiation; 2.00–2.80 = action; and 2.81–3.00 = maintenance).

Comparison over time

We compared the overall ratings (i.e. initiation, action or maintenance) for Time I against those for Time II and classified them as "low/decreased," "moderate" or "high/increased" (Table 3). This classification was repeated for each separate CSH pillar.

FES analysis

We calculated descriptive statistics (mean, ranges) using SPSS Statistics software version 23 (IBM, Armonk, NY, USA). Open-ended questions (FES) underwent a deductive content analysis using NVivo qualitative analysis software version 10 (QSR International Pty Ltd., Melbourne, AUS) by which responses were grouped by CSH pillar and outcomes used to further describe the ordinal responses to the HSP indicator questions.

TABLE 3
Classification of schools' level of support for comprehensive school health from Time I (2012/13) to Time II (2014)

Change in the level of support from Time I to Time II	Description	Ratings along the Healthy School Continuum[a] (Time I → Time II)
Low/decreased support	From Time I to Time II schools regressed along the HSC or sustained the lowest rating of "Initiation."	Maintenance → Action
		Maintenance → Initiation
		Action → Initiation
		Initiation → Initiation
Moderate support	From Time I to Time II schools sustained a rating of "Action."	Action → Action
High/increased support	From Time I to Time II schools improved along the HSC or sustained the highest rating of "Maintenance."	Initiation → Action
		Initiation → Maintenance
		Action → Maintenance
		Maintenance → Maintenance

[a] See Table 2.

Results

Study sample

Of 82 schools invited to participate, 45 did participate in either Time I or Time II (55% response rate). However, only the 25 schools (8 elementary, 17 secondary) that completed an HSP survey in both time periods are included in the results. The HSP survey was completed by a combination of teachers (16 in Time I, 16 in Time II), principals or vice principals (11 in Time I, 15 in Time II), curriculum leads/department heads (3 in Time I, 4 in Time II), food service staff (1 in Time I, 1 in Time II), a school board representative (1 in Time I), and/or a PHN (1 in Time I, 1 in Time II).

Overall rating along the Healthy Schools Continuum for Time I and Time II

Figure 1 displays overall ratings along the Healthy Schools Continuum (HSC) at Time I and Time II. A majority of schools fell into the action stage along the HSC in Time I (6 elementary, 14 secondary) and Time II (6 elementary, 16 secondary). Very few achieved the highest rating of maintenance in either Time I (1 secondary) or Time II (2 elementary).

Comparison of Time I versus Time II overall ratings

As outlined in Figure 2, from Time I to Time II, three schools advanced along the HSC (one from initiation to action, two from initiation to maintenance); 20 schools remained within the action category, one school remained within initiation, and one school regressed (from maintenance to action). The movement along the HSC was dependent on the changes in the level of support for healthy eating within CSH pillars.

Extent of healthy eating support by CSH pillar

Table 4 provides an overview of the schools' level of support for healthy eating within each of the CSH pillars from Time I to Time II. The sections below describe how healthy eating was supported, as outlined by the CSH pillar indicator questions and responses to the FES.

The social environment

Six schools (24%) had an overall *high/increased* rating of support for the social environment pillar, and many schools improved over the time periods. The indicators of support for healthy eating (retrieved from the HSP) were reported by few schools. These included self-report of a "high" (8% of schools) or a "very high" (16%) priority for healthy eating at their school; having a student food and nutrition council at the school (40%); and hosting "nutrition month" activities (36%). To encourage families to

FIGURE 1
School ratings of support along the Healthy School Continuum in Time I (2012/13) and Time II (2014)

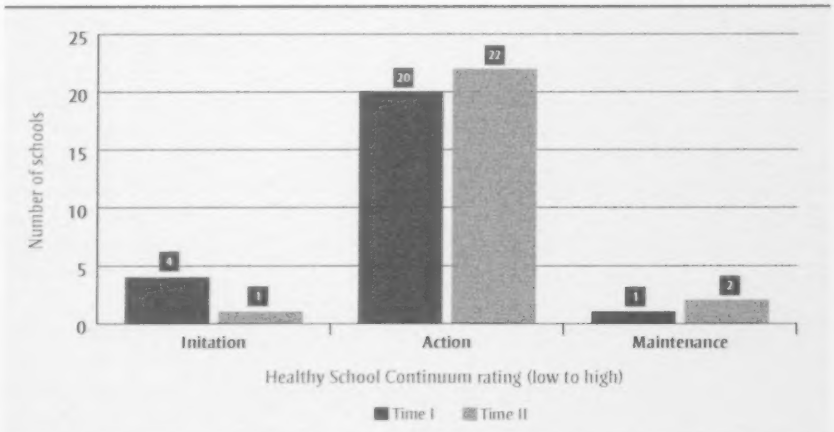
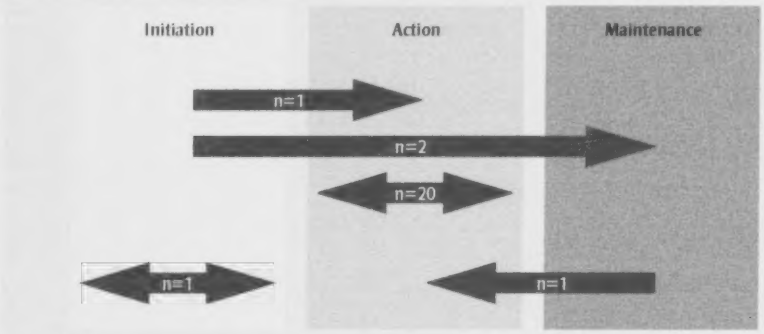


FIGURE 2
Overall movement of 25 elementary and secondary schools along the Healthy Schools Continuum[a] between Time I (2012/13) and Time II (2014)



[a] See Table 2.

reinforce healthy eating habits at home, schools most often distributed healthy snack and lunch suggestions (36%) or Canada's Food Guide (16%) to parents and families. Furthermore, to gather input on school-related healthy eating initiatives from the broader school community, schools reported collecting suggestions from students (40%), parent organizations (24%), parents and families (16%) and staff (16%).

The physical environment

The physical environment proved to be the CSH pillar that demonstrated the greatest support. All schools (N = 25) in both time periods reported a high level of physical environment support for healthy eating (Table 4). Indicators of physical environment support included having an adequate number of tables and chairs for student meals, accessible drinking fountains and sinks for proper hand-hygiene. In addition, both elementary and secondary schools allowed enough time to eat lunch, socialize with friends and clean up (i.e. 20 minutes in elementary, 60–75 minutes in secondary).

All elementary and secondary schools promoted healthy eating to students throughout the school setting. Most often this was done through promotional posters (e.g. advertisements for local farmers' markets, nutrition month campaigns) or cafeteria signage in secondary schools (e.g. provincial seasonal fruit promotion cards, regional public health healthy eating stickers). Most secondary schools (n = 15) also used student-designed murals and artwork to raise awareness and promote healthy food choices in cafeterias.

TABLE 4
Changes in level of support for healthy eating between Time I (2012/13) and Time II (2014) for 25 elementary and secondary schools, by comprehensive school health pillar

CSH pillar	Low/decreased support from Time I to Time II # of schools n (%)	Moderate support from Time I to Time II # of schools n (%)	High/increased support from Time I to Time II # of schools n (%)
The social environment	17 (68%)	2 (8%)	6 (24%)
The physical environment	—	—	25 (100%)
Teaching and learning	1 (4%)	17 (68%)	7 (28%)
Healthy school policy	7 (28%)	2 (8%)	16 (64%)
Partnerships and services	11 (44%)	5 (20%)	9 (36%)

Abbreviation: CSH, comprehensive school health.

All secondary schools in Time II (n = 17) reported hosting activities during the lunch hour. Examples of activities included a skit entitled "Fruit Ninja" to raise awareness of the benefits of fruit and vegetable consumption; mini talent shows or open mic events; pep rallies; and competitions to win P/PM 150–compatible food prizes (i.e. "minute-to-win it," "rap for a wrap," "sing for a salad," and healthy eating quizzes). No such activities were identified in elementary schools as representatives reported that lunch time was dedicated to eating and socializing, followed by an outdoor recess.

Teaching and learning

School support for healthy eating within the teaching and learning pillar was exemplified in Time II through activities such as offering media literacy instruction on special topics related to healthy eating (80%), field trips to farmers' markets (40%) and field trips to the local grocery store (32%). Additionally, the FES indicated 80% of schools offered ad hoc gardening opportunities to students in select gardens, such as tending the school's memorial or peace garden, planting an herb garden or discussing gardening in the school's Eco Club. Support for the development of students' food skills was demonstrated in many schools (60%) through hospitality classes and participation in regional food education days and region-wide specialty snack days.

Many schools offered regular breakfast programs (44%, n = 11), lunch programs (12%, n = 3) and/or snack programs (8%, n = 2). A majority of breakfast programs (77%, n = 10) were made available to all students for no fee and provided services an average of three days a week (range = 1–5 days). Lunch programs ran one, four, or five days a week; however, universally available lunch programs (regardless of ability to pay) occurred in only one of three schools. The snack programs (n = 2) were free to all students, and ran either once or three times a week. All nutrition programs were reviewed by school administration at least once per year and, being offered free of charge, did not operate under P/PM 150 jurisdiction and as such, were exempt from its standards.

At Time II, several school representatives reported not needing a breakfast program (32%), lunch program (48%), and/or a

snack program (52%). Reasons for not requiring a nutrition program included not identifying a need (i.e. students always came to school with lunch, high socioeconomic status neighbourhood). In contrast, for some schools that did not have nutrition programs in Time I or Time II, representatives reported that a breakfast (16%), lunch (32%) or snack program (12%) was desired to help address, for example, poor dietary habits witnessed by teachers in classrooms and cafeterias. To initiate such a program, representatives identified a need for additional funding and volunteers.

Healthy school policy

This pillar was well supported in both time periods by many schools (64%; Table 4). To support healthy eating through policy outside of P/PM 150, schools ensured that healthy food choices were available at reasonable or subsidized prices (24% written policies; 32% formal practices); the use of sugary treats as rewards in the classroom were avoided (8% written policies; 48% formal practices); and foods sold through off-campus fundraisers were healthy (16% written policies; 12% formal practices). Examples of non-food fundraisers from the FES included sales of magazines, cookware, flowers and plants and special events such as movie nights, student dances, skating field trips and carwashes.

All participating elementary schools had a written policy restricting students from leaving school property without a written note from a parent or guardian, which is helpful in restricting access to local food outlets. For both elementary and secondary schools, the FES identified the number of P/PM 150 exemption days used. No school reported surpassing the 10-day limit (average = 3, range = 0–10 days/year) in either time period. Exemption days were used for school barbecues, on-site fundraisers (e.g. bake sales, "candy grams"), and curriculum-related events (e.g. French café, business venture competition).

Partnerships and services

The partnerships and services pillar had variable levels of support across schools (Table 4). As demonstrated by Time II data, schools that had high/increased support for the partnerships and services pillar often provided school staff with in-service training on topics such as nutrition (44%), teaching a healthy eating curriculum (32%) and promoting positive body image (28%). In Time I, when P/PM 150 was first mandated, the majority of schools (88%) sent a school representative to receive formal training provided by the regional public health unit in partnership with the affiliated school boards. In addition, many schools opted for a consultation with their school PHN (68%) and/or school board-funded P/PM 150 coordinator (56%) to help implement the policy in the local setting. In Time II, only 20% of schools met with a PHN, and the school boards' P/PM 150 coordinators had been discontinued. Some schools received P/PM 150–related resources in Time II, including written (24%) and/or electronic (20%) resources relevant to healthy eating, nutrition or policy.

Even though most school representatives did not meet to discuss P/PM 150 with a PHN in Time II, the regional public health unit shared resources and information with school staff (88%), helped develop and implement programs (60%) and/or assisted in problem solving (32%). In the broader community, schools reported working on healthy eating promotion and activities for students with community health organizations (e.g. Heart and Stroke Foundation, Canadian Cancer Society; 32%), the school board (28%), the municipal parks and recreation department (24%), a youth organization (e.g. YMCA, Boys and Girls Club; 16%), and/or a health and fitness club (12%). Over the course of Time II, four schools reported having no contact with their regional public health unit, and five other schools reported not establishing external community connections to support healthy eating.

Discussion

Having supports in place across CSH pillars during policy implementation has been shown to be effective at fostering positive student health behaviours.[7,29] Our study showed variable levels of support for CSH pillars during mandated School Food and Beverage Policy (P/PM 150) implementation across schools in two time periods. For example, all schools achieved a high level of support for the physical environment pillar for both time periods because of Ontario's commitment to the provision of safe, supportive physical school environments in line with recommendations set by the WHO.[30] In contrast, the social environment pillar received the lowest ratings, perhaps due to the need for extracurricular initiatives to be driven by individuals at the school level.

The school principal is a gatekeeper with the power to facilitate or restrict the adoption, implementation and sustainability of CSH initiatives.[9,20,22,31,34] Individuals with a personal passion for improving the health behaviours of students, referred to as school health champions, are key facilitators to ongoing support of CSH initiatives within and external to the classroom.[20,21,35,36] In our study, school health champions were teachers who dedicated their non-classroom time (i.e. lunch breaks, after school) to run programs and supervise students in nutrition action councils, eco clubs, or extracurricular food skills competitions. Open-ended responses from school representatives linked champions to the few initiatives within the low-rated social environment pillar.

Supporting champions has required the provision of dedicated, paid time for program planning and/or hiring an external coordinator to champion program development and implementation alongside school stakeholders.[18,19,21,23] When stakeholders, be they teachers, school staff, food service providers, families, community partners, health promotion officials or students, are engaged in the decision-making process, there is an increased sense of buy-in and ownership that leads to a personal commitment to sustain CSH initiative outcomes.[19,22,23,37,38] In our study, school staff members said they were not often consulted on discussions related to healthy eating in their schools, and one may assume this disengagement may have contributed to a lack of extracurricular supports for healthy eating within the social environment pillar. Future work is needed to include staff in such discussions to further build buy-in for healthy eating promotion in schools and, perhaps, to help encourage the uptake of P/PM 150 standards.

Schools in our study demonstrated various levels of stakeholder involvement; however, actions such as engaging community members in discussions about healthy eating and supporting existing partnerships with external organizations were both associated with improvements within CSH pillars and between Time I and Time II. For example, a participating

secondary school connected with local health-related organizations to host a week of wellness events including fitness classes, cooking lessons and health promotion seminars to support the new P/PM 150 and reinforce positive healthy living behaviours. Previous studies have demonstrated that successful partnerships lead to increased availability of supports, resources and opportunities for promoting healthy eating messages to be reinforced in public spaces, external to the school, where children live, learn and play.[18,20,39]

The formation of partnerships can be challenging, and sometimes there is little benefit for schools.[9,18,40] This may explain why schools in our study experienced low levels of support in the partnerships and services pillar; five schools did not establish connections with external partners and four schools did not contact their school PHN in the previous school year. The literature reports some school officials may avoid involving stakeholder groups because "it is faster to be directive than work collaboratively."[41,p.574]

Sometimes approaching stakeholders can be met with resistance. For example, food service workers may approach healthy eating strategies from a business perspective as opposed to a health promotion stance, or parents may not agree with the health promotion messages or may not be able to reinforce teachings at home due to issues regarding food insecurity, cultural norms or personal health beliefs.[20,38] Future qualitative research is needed to better understand the barriers to forming and sustaining community partners in support of healthy school food environments.

Another barrier to CSH implementation is the lack of available funding. Historically, when schools have been provided with external funding, representatives have been able to implement CSH components based upon the priorities of the school community.[9,19,20] Conversely, without supplementary funds, school staff have previously reported not being able to engage in CSH initiatives because they were not compensated for their time.[20,21,38,39] We found that the availability of funds from government grants, external fundraising and/or student payment made it possible for some schools to offer regular free or subsidized breakfast, lunch or snack programs. In some cases though, those who wished to have student nutrition programs were limited by a lack of funds.

When funds were available to a school from external non-government sources (the only sources available during the course of this study), students took part in skill-development activities, such as gardening and cooking, as tools and materials (e.g. plants, cookware, ingredients) could be afforded. Two elementary schools in our study sourced funding and food from a local grocery store, to host nutrition education sessions for students and parents. They garnered further support from school PHNs who were educated in healthy eating promotion and willing to help with grant applications. More work is needed to raise the awareness of school officials of funding opportunities that may help address the unique needs of school communities.

Context plays a significant role in the successful implementation of CSH initiatives. When implementation strategies account for context, schools are able to align priorities with CSH policy.[9,18,20,22,41,42] For example, the Alberta Project Promoting active Living and healthy Eating in Schools (APPLE Schools) aimed to embed wellness into school culture through ongoing events and activities and by including wellness teachings in curriculum.[43] Through allocated funding, each school was able to dedicate time for staff to connect with a school health facilitator and prioritize school wellness policies and practices.[22] When school principals had a firm understanding of the project philosophy and recognized its alignment with the priorities of the school, APPLE Schools' CSH initiatives were successfully implemented and sustained.[22] The data collected from the current study, related to the dynamic context of schools, emphasizes the need for multiple representatives from positions of power (i.e. Ministry of Education, school board, school principal, school champion) to work with school stakeholders to strategize ways to continue to support healthy eating in all aspects of the CSH framework.

Strengths and limitations

To the best of our knowledge, this study is one of the first studies to measure the CSH pillars during P/PM 150 implementation, which adds to the current understanding of Ontario schools' support for healthy eating. Further research can build upon the current findings to examine a dose-response relationship between the presence of healthy eating support and population-level health outcomes within and between schools.

This study, however, is not without limitations. The relatively low response rate could be attributable to competing priorities within schools or a teacher work-to-rule political action undertaken during Time 1 (2012/13) of this study, which restricted researcher contact with school administrators. In five cases, school representatives changed between time periods, providing different perspectives over the course of the data collection timeframes. Furthermore, there may have been self-report bias, meaning representatives involved with healthy eating practices in the school may have reported outcomes differently from someone less engaged. In addition, the results of this study only provide a snapshot of schools' healthy eating environments, as repeated measures were not obtained across the school year. Since not all the invited schools participated, there is the potential for volunteer bias.

Finally, the CSH framework is exclusive to the school environment and does not consider the external environment, such as the work-to-rule action; the amount and type of competitive foods external to the school; media emphasis on the importance of healthy eating; and other environmental influences from home or recreation centres that may have influenced student healthy eating behaviours.

Conclusion

Policy is a critical component of CSH initiatives as it provides the top-down support and continued reinforcement needed to sustain individuals' behaviour change.[7,8] When mandated by an authoritative body, health policies can also help school communities set standards and priorities for other CSH initiatives.[43,44] This requires additional comprehensive, integrative bottom-up approaches to personally motivate the agents of change (i.e. principals, teachers, staff, community members, parents, students) to adopt and maintain CSH priorities.[45,46] These strategies must be orchestrated and coherent, with an implementation strategy that targets several dimensions of student health and the food environment simultaneously.[47] Without structured assistance throughout the

implementation process, CSH initiatives will falter.[23] Results of meta-analyses have demonstrated that effective implementation strategies lead to better outcomes.[46] Therefore, schools need to develop a structured implementation plan for healthy school policy—one that takes into consideration the unique priorities of the school (social environments), the physical structure (physical environment), the alignment with curriculum and academic achievement goals (teaching and learning), support by existing written policies and informal practices (healthy school policy), and sustainable supports and resources that can be garnered by school and community partners (partnerships and services).

There is at present a real opportunity to apply the lessons learned through this research, as the Ontario Ministry of Education seeks to engage school community members in the recently executed Ontario's Well-Being Strategy for Education.[48] This initiative aims to better understand the physical, cognitive, emotional and social well-being of children and build upon the current system to support all aspects of children's health and development. We recommend that the Ontario Ministry of Education, community partners and school officials consider using the CSH framework to better understand how well-being, such as student eating behaviours, are impacted by all aspects of the school environment. Furthermore, tools such as the Healthy School Planner can help the Ministry and school communities learn about activities that are working well, as well as those needing further support.

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Conflicts of interest

The authors have no conflicts of interest to declare.

Authors' contributions

TO contributed to all aspects of this research, including research design, tool development, data collection, analysis, manuscript writing and approval of the final version. RC and SM contributed to research design, tool development, overseeing data collection and analysis, as well as approval of the final manuscript.

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The Ontario Food and Nutrition Strategy: identifying indicators of food access and food literacy for early monitoring of the food environment

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Abstract

Introduction: To address challenges Canadians face within their food environments, a comprehensive, multistakeholder, intergovernmental approach to policy development is essential. Food environment indicators are needed to assess population status and change. The Ontario Food and Nutrition Strategy (OFNS) integrates the food, agriculture and nutrition sectors, and aims to improve the health of Ontarians through actions that promote healthy food systems and environments. This report describes the process of identifying indicators for 11 OFNS action areas in two strategic directions (SDs): Healthy Food Access, and Food Literacy and Skills.

Methods: The OFNS Indicators Advisory Group used a five-step process to select indicators: (1) potential indicators from national and provincial data sources were identified; (2) indicators were organized by SD, action area and data type; (3) selection criteria were identified, pilot tested and finalized; (4) final criteria were applied to refine the indicator list; and (5) indicators were prioritized after reapplication of selection criteria.

Results: Sixty-nine potential indicators were initially identified; however, many were individual-level rather than system-level measures. After final application of the selection criteria, one individual-level indicator and six system-level indicators were prioritized in five action areas; for six of the action areas, no indicators were available.

Conclusion: Data limitations suggest that available data may not measure important aspects of the food environment, highlighting the need for action and resources to improve system-level indicators and support monitoring of the food environment and health in Ontario and across Canada.

Highlights

- Key food environment features are included in the Ontario Food and Nutrition Strategy (OFNS), which aims to improve the health of Ontarians through policy and programs that promote healthy food systems and environments.
- The OFNS Indicators Advisory Group used publicly available data to identify seven early indicators of healthy food access and food literacy; however, data availability and quality were limited.
- Limitations suggest that available data may not measure important aspects of the food environment, highlighting the need for action and resources to improve system-level indicators and support monitoring of the food environment and health in Ontario and across Canada.

Keywords: nutrition policy, public health surveillance, healthy diet, food supply, health promotion, environmental health, food environment

Health of Canadians and the food environment: the need for monitoring and surveillance

The contribution of diet to overall health and the development of cancer and other chronic disease is well documented.[1-3] Yet, in general, Canadian diets are not consistent with recommended healthy eating patterns or advice.[4-7] Additionally, a number of economic and social factors such as education, income and food insecurity influence diet and importantly affect Canadian health and health care costs.[8-10]

Although individual factors such as food preferences and skills affect dietary decisions and intake, they do so within the context of food environments—the collective physical, economic, policy and sociocultural surroundings, opportunities and conditions that influence food choices and nutritional status.[11,12] The food environment in Canada has changed substantially over recent decades with the growth of global food systems that include large-scale retail stores, fast food outlets and highly processed food products that may be negatively associated with health.[13-15] These changes relate to the four key food environment features of (1) geographic food access; (2) availability; (3) affordability; and (4) food quality, which affect

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food choices and eating patterns[16,17] and interact with the socioeconomic disparities[18] that challenge the health of Canadians.

To address the challenges Canadians generally face within their food environments, a coordinated intergovernmental and multistakeholder approach to food policy development is essential and must consider the broader environmental influences that affect health and well-being.[11,12,19] Such an approach necessarily relies on evidence-informed decision making and the ability to track and compare outcomes of research, programs and policies related to the food environment. Recent international and Canadian reports have identified an important role for comprehensive and regular monitoring of the food environment, as well as diet, health and inequality measures to assess population status and tailor policy and program development.[11,12,16] Although previous food environment assessments have been undertaken across Canada,[16] there appears to be a lack of strategies that integrate food, agriculture and nutrition at the provincial and federal levels and that comprehensively include multiple factors related to the food environment and health. This report describes an Ontario initiative that integrates multiple sectors and factors, reviews available indicators and supports efforts across Canada to develop provincial and national strategies and surveillance systems to improve the food environment and Canadian health. A comprehensive description of the initiative is detailed elsewhere.[20,21]

The Ontario Food and Nutrition Strategy

The Ontario Food and Nutrition Strategy (OFNS) is an expert- and evidence-informed strategy for improving the health and well-being of Ontarians through food policies and programs that also contribute to reducing the financial burden of chronic disease.[21] The OFNS was collaboratively developed by individuals from 26 key organizations representing agriculture, food, health, education and Indigenous interests. Between 2009 and 2016, contributions from a broad group of stakeholders were also incorporated via numerous consultations. Fifty-nine organizations from academia; municipal, provincial and federal government; and public health and civil society provided feedback through in-person meetings and online consultations (237 online submissions were received). Based on this broad development process, the OFNS outlined a comprehensive, multistakeholder, coordinated approach to food policy development that works across the food, agriculture and nutrition sectors. The intended impact is to make healthy food the preferred and easiest choice for Ontarians by promoting diverse, healthy and resilient food systems and environments that improve diet and health, and contribute to an equitable and prosperous economy.

To achieve this, the OFNS identified three key strategic directions (SDs):[21,p.6]

- Healthy Food Access (SD1): "access to and the means to choose and obtain safe, healthy, local and culturally acceptable food";
- Food Literacy and Skills (SD2): "information, knowledge, skills, relationships, capacity and environments to support healthy eating and make healthy choices where [Ontarians] live, gather, work, learn and play"; and
- Healthy Food Systems (SD3): "diverse, healthy and resilient food systems that promote health and contribute to an equitable and prosperous economy."

The three strategic directions encompass 25 targeted action areas in total, which are described in a separate report.[21]

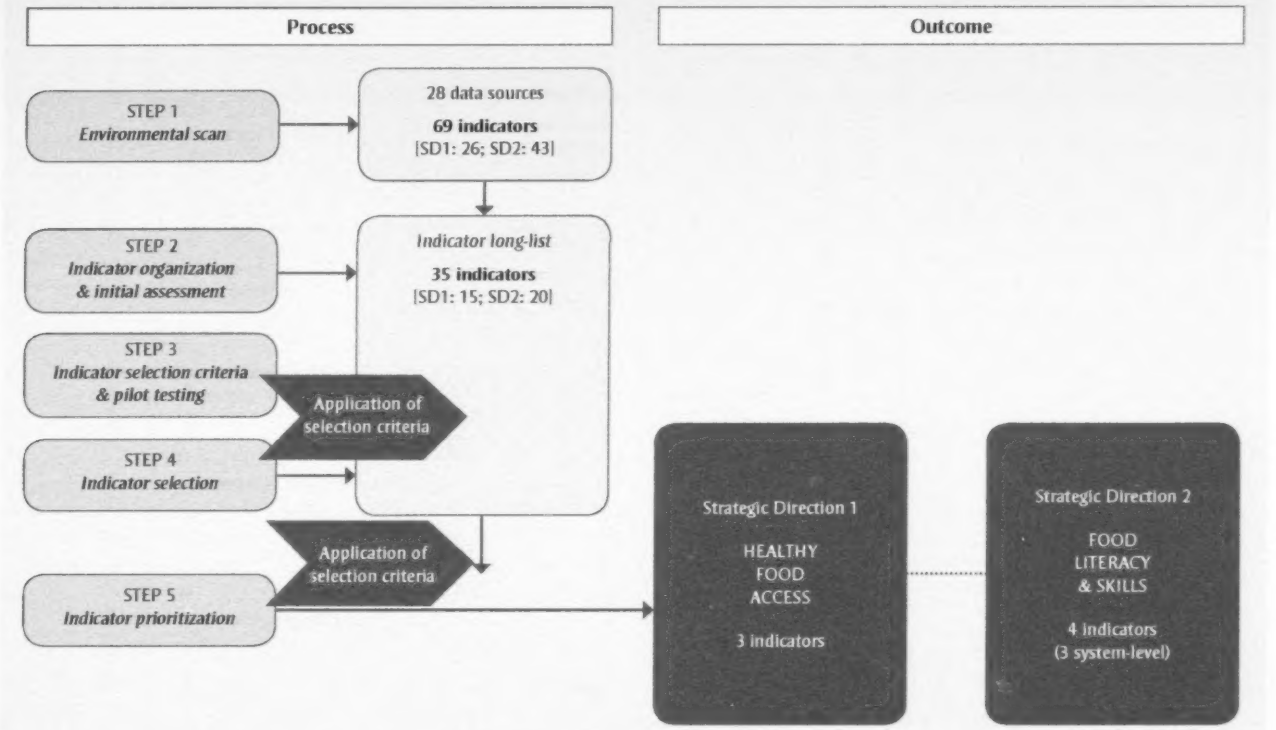
While aspects of the food environment are included in all three OFNS strategic directions, this report describes work undertaken to identify early indicators to monitor and inform progress in the 11 action areas of Healthy Food Access (SD1) and Food Literacy and Skills (SD2). Key food environment features—food access, availability, affordability, quality—are clearly identifiable in SD1, and are also embedded in SD2 through restrictions on advertising, increased access to information on healthy eating and other environmental factors that influence food literacy and affect dietary outcomes and health.[22-25] Salient aspects of the food environment should be measured using valid and reliable provincial indicators; given the relative newness of this field, it is expected that food environment definitions and indicators may evolve in future reports to encompass the complexity of factors that influence food choice.[16,17]

Process for identifying early indicators of the food environment

An OFNS Indicators Advisory Group ("the Advisory Group") was formed with representation from municipal boards of health, provincial and national government agencies and academic and nongovernmental organizations to scan and identify existing data sources and determine the best available indicators of healthy food access and food literacy as the initial measures for Ontario. The project also aimed to identify data gaps and articulate considerations for future data collection to promote the robust monitoring and evaluation of issues that influence food access and literacy. Based on criteria from the National Health Service (UK), the Advisory Group defined indicators as succinct measures that describe and help users understand, compare and improve the current food system and environment.[26,p.5]

The Advisory Group used a five-step process to identify, review, select and prioritize indicators for Healthy Food Access, and Food Literacy and Skills (Figure 1), that included the use of quality criteria during indicator selection (Figure 2). Step 1 consisted of an environmental scan of national and provincial reports, other documents and data sources that provide system-level as well as behaviour- and knowledge-based data or indicators relevant to one or both OFNS strategic directions and their action areas. Although the intent was mainly to identify system-level indicators, data collection began with a broad set of available data in case system-level indicators were unavailable. Step 2 involved extracting and organizing possible indicators for each SD into detailed spreadsheets by action area and data type. Step 3 entailed identifying indicator selection criteria[26-28] by pilot testing their application to a sample of potential indicators (done by a subgroup of the Advisory Group). Final criteria were based on fundamental issues of data possibility and feasibility, face validity and importance and relevance within a public health context.[29,30] Step 4 included using final selection criteria to create a short list of indicators for each strategic direction. Step 5 involved prioritizing indicators on the short list using a consensus-building technique after each Advisory Group subgroup member independently reapplied the selection criteria and ranked the importance of indicators within each action

FIGURE 1
Indicator selection process and outcomes for two strategic directions in the Ontario Food and Nutrition Strategy, 2016



Source: Adapted from Ontario Food and Nutrition Strategy Indicator Advisory Group. Determining food access and food literacy indicators for the Ontario Food & Nutrition Strategy; 2016. p. 12. Available from: https://sustainontario.com/custom/uploads/2012/04/OFNS-Final-Report-v3.1-April-8-2016.pdf

Abbreviation: SD, strategic direction.

area. This process resulted in the final list of indicators for each strategic direction.

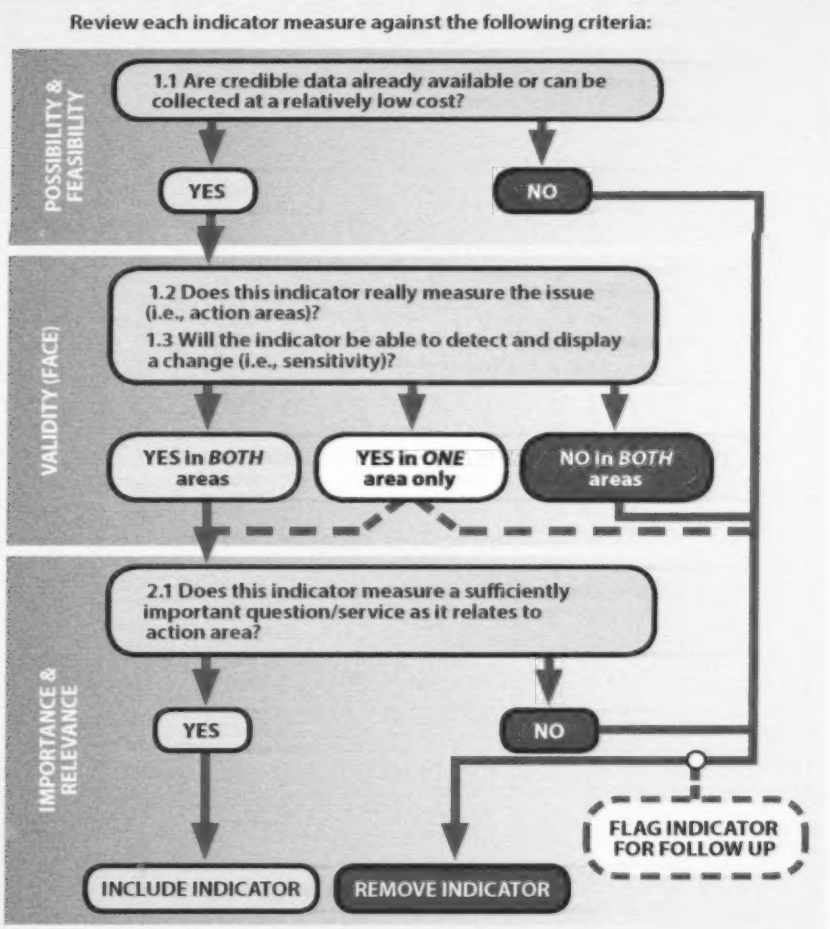
Overall, 69 indicators were proposed from the environmental scan and organized into 11 action areas. The initial assessment excluded 34 items that were predominantly measures of individual nutrition behaviour or knowledge, resulting in a long-list of 35 indicators. After first application of the selection criteria, 28 indicators remained. From these, six system-level indicators were prioritized as well as one individual-level "global" indicator of food skills (ability to cook from basic ingredients; SD2). Three prioritized indicators for Healthy Food Access included system-level measures of household food insecurity, cost of the Nutritious Food Basket[31] and municipal and provincial healthy eating policies, in three of six action areas (Table 1). Four prioritized indicators for Food Literacy and Skills included three system-level measures of student food skills education, dietitian access and dietitian supply, and one individual-level measure of general cooking skills in two of five action areas (Table 2). For six of the 11 action areas, there were no indicators available. Overall, although certain early indicators of food access, literacy and the food environment were identified, the general scarcity of system-level data and the many data gaps suggest that the adequacy and scope of existing publicly available data to comprehensively measure and monitor important aspects of the food environment are limited.

Limitations and future considerations for identifying indicators in Ontario and beyond

A major challenge in identifying OFNS indicators was the need to rely on existing data sources, which revealed several limitations in data availability and quality. This led to the identification of early indicators that were often constrained (e.g. based on face validity rather than more robust validity criteria), as well as the overall dearth of system-level data for many action areas. Although national surveys were viewed as potential sources of proxy provincial data, they do not appear to include food environment variables other than food insecurity, suggesting an absence of system-level data at the national level as well.

Furthermore, although numerous indicators had been proposed after the initial document scan, most were not retained, including several that were considered downstream measures of specific dietary knowledge or behaviours (e.g. self-reported skills in peeling, chopping and slicing vegetables or fruits) rather than desired upstream indicators of the food system and environment. Overall, these limitations highlight the need for system-level provincial indicators that are diverse, robust and based on measures that have been rigorously tested for validity and

FIGURE 2
Quality criteria and indicator selection pathway for two strategic directions in the Ontario Food and Nutrition Strategy, 2016


Review each indicator measure against the following criteria:
POSSIBILITY & FEASIBILITY
1.1 Are credible data already available or can be collected at a relatively low cost?
YES
NO
VALIDITY (FACE)
1.2 Does this indicator really measure the issue (i.e., action areas)?
1.3 Will the indicator be able to detect and display a change (i.e., sensitivity)?
YES in BOTH areas
YES in ONE area only
NO in BOTH areas
IMPORTANCE & RELEVANCE
2.1 Does this indicator measure a sufficiently important question/service as it relates to action area?
YES
NO
FLAG INDICATOR FOR FOLLOW UP
INCLUDE INDICATOR
REMOVE INDICATOR

Source: Adapted from Ontario Food and Nutrition Strategy Indicator Advisory Group. Determining food access and food literacy indicators for the Ontario Food & Nutrition Strategy; 2016. p. 52. Available from: https://sustainontario.com/custom/uploads/2012/04/OFNS-Final-Report-v3.1-April-8-2016.pdf

reliability.[17] Additionally, although members of the Advisory Group were aware that recent provincial initiatives had proposed to collect food environment data, as noted in the action area for increased use of healthy, local food in public sector organizations (Table 1), current data availability was uncertain. This suggests that improved communication and coordination will be needed among partners to collect and share relevant data and create a comprehensive monitoring plan.

Working within these data limitations, however, the Advisory Group prioritized indicators that they considered the "best available," although these may not sufficiently assess critical aspects of the food environment, or adequately monitor its impact, trends or change. While this paper describes the process and challenges of selecting indicators for Ontario, it is useful to consider that other Canadian jurisdictions face similar issues related to the availability of regular, consistent and valid food environment data, as suggested in a recent report by Health Canada.[16]

Next steps for the Ontario Food and Nutrition Strategy

The Ontario Food and Nutrition Strategy[21] was launched in January 2017 and will be implemented through a shared delivery model whereby stakeholder groups and partners lead and support work in self-identified areas of interest and expertise. The seven indicators prioritized in this report will form the initial monitoring framework for two of the OFNS strategic directions. Dependent on funding, data for these indicators will be analyzed to provide a modest baseline assessment of food access, food literacy and the food environment in Ontario, and reanalyzed longitudinally to determine the extent of change over time. This initial monitoring will help identify where efforts and resources are needed to support improvements in surveillance and outcomes, including through the development of provincial and national policies. Opportunities for additional funding will be explored to support the identification of indicators for the third and final strategic direction, Healthy Food Systems, and advancement of strategies to encourage the systematic, ongoing collection of provincial and national data for all OFNS actions.

To our knowledge, few, if any, other provinces have developed comprehensive food, agriculture and nutrition strategies that address the complexity of contributions to the food environment and health. This shortcoming also appears to extend to the federal level, where separate (rather than integrated) healthy eating and agri-food policies are being developed.[32,33] Nonetheless, the data limitations identified in this report may assist multiple stakeholders to advocate for robust surveillance systems that consider all or select aspects of OFNS action areas,[21] particularly since many are shared with other provincial, national and international initiatives such as the Report Card on Healthy Food Environments and Nutrition for Children in Canada[34] and the International Network for Food and Obesity/non-communicable diseases Research, Monitoring and Action Support (INFORMAS).[11,12] This overlap in effort will serve to enhance opportunities and synergies to create, test and implement valid and comprehensive measures of food access, food literacy and the food environment that will be able to monitor and inform provincial, national and international programs and ultimately improve the diet and health of Canadians.

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TABLE 1
Action areas and indicators for the Healthy Food Access strategic direction (SD1) of the Ontario Food and Nutrition Strategy

Action area		Indicator	Data source
1.1 Increased individual & household food security	1	Percentage of Ontario households that were food insecure, by level of food insecurity (marginally, moderately, severely)	CCHS
1.2 Increased access to safe, healthy, local & culturally acceptable food		*No indicator available*	
1.3 Increased use of healthy, local food by public sector organizations		*No indicator available*[a]	
1.4 Increased distribution & promotion of equitably-priced healthy, local food	2	Regional cost of Nutritious Food Basket[b]	MoHLTC
1.5 Reduced access to high calorie, low-nutrient food, beverages & snacks	3	Number of existing provincial and/or municipal prevention policies as they relate to risk factor of unhealthy eating	CPAC
1.6 Enhanced food access through land use management & planning		*No indicator available*	

Source: Adapted from Ontario Food and Nutrition Strategy Indicator Advisory Group. Determining food access and food literacy indicators for the Ontario Food & Nutrition Strategy; 2016. p. 13. Available from: https://sustainontario.com/custom/uploads/2012/04/OFNS-Final-Report-v3.1-April-8-2016.pdf

Abbreviations: CCHS, Canadian Community Health Survey; CPAC, Canadian Partnership Against Cancer; MoHLTC, Ontario Ministry of Health and Long-Term Care.

[a] "Number of food service operators in Ontario that implement a local food procurement policy" was identified as potential indicator; data collection has been proposed but data availability was uncertain.

[b] The Nutritious Food Basket is a survey tool used to measure the affordability of nutritious food in Ontario.[31]

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Conflicts of interest

The authors declare no conflicts of interest.

Authors' contributions

RT, LR, EM, and BAB contributed to the design of the study; BAB, EM, RT, MRB, and LR performed data analysis and interpretation; BAB and EM drafted the

TABLE 2
Action areas and indicators for the Food Literacy and Skills strategic direction (SD2) of the Ontario Food and Nutrition Strategy

Action area		Indicator	Data source
2.1 Increased healthy eating knowledge, skills & capacity	1	Percentage of secondary school students in Ontario who earned at least one credit in a course that included a food skills component	OME
	2	Personal ability to cook from basic ingredients[a]	CCHS
2.2 Increased access to public information about healthy eating through retailers & food services		No indicator available	
2.3 Restricted advertisement of unhealthy food, beverages & snacks to children		No indicator available	
2.4 Increased availability of professional nutrition services	3	Number of persons accessing an Eat Right Ontario dietitian (phone or by email)	ERO
	4	Number of dietitians practising in family health teams and community health centres	CDO
2.5 Enhanced services for at-risk populations		No indicator available	

Source: Adapted from Ontario Food and Nutrition Strategy Indicator Advisory Group. Determining food access and food literacy indicators for the Ontario Food & Nutrition Strategy; 2016. p. 14. Available from: https://sustainontario.com/custom/uploads/2012/04/OFNS-Final-Report-v3.1-April-8-2016.pdf

Abbreviations: CCHS, Canadian Community Health Survey; CDO, College of Dietitians of Ontario; ERO, Eat Right Ontario; OME, Ontario Ministry of Education.

[a] This is the only individual-level indicator included in report; Canada-wide data will be used as a proxy for this indicator since Ontario-specific data are not available.

manuscript; and BAB, EM, RT, MRB and LR revised for critical content. All authors have approved the final manuscript.

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